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Some New Patterns of Chucks.

We show on this page some of the new patterns of chucks recently brought out by the Cushman Chuck Company, Hartford, Conn.

Some of them are modifications of chucks formerly made by this company, while others are entirely new chucks. Figs. 1 and 2 are front and back views of an independent reverse jaw chuck, having slots through the body to receive bolts for holding long work. These slots are put in all the sizes above the 4½ and 6 inch chucks. The jaws can be run out and reversed, and the screws are made with a long bearing at each end, and should the square end become broken or worn out, the screw can be reversed and the other end fitted to the key. Jaws and screws are made of steel.

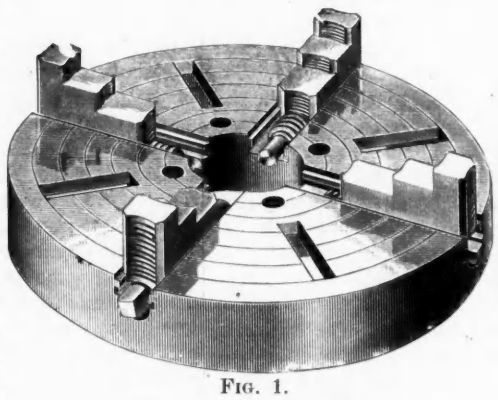


FIG. 1.

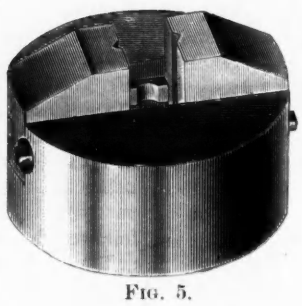


FIG. 5.

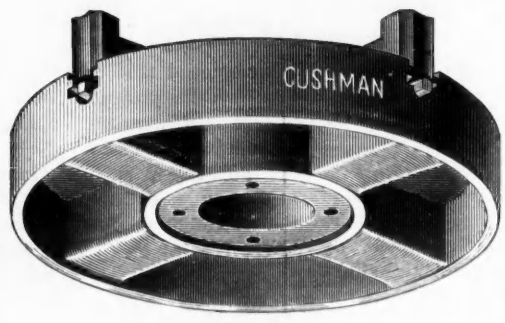


FIG. 2.

Figs. 3 and 4 show a chuck which is much the same as the first, but has T-slots milled in the face, instead of passing through, and an arrangement by which any two opposite screws may be connected in the manner shown in Fig. 4, which enables work to be centered by them, the other two being afterward tightened.

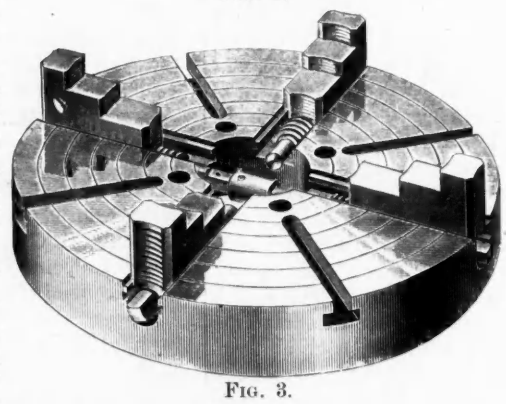


FIG. 3.

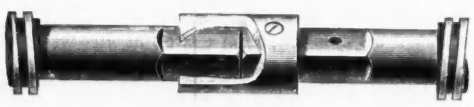


FIG. 4.

Fig. 5 is a two-jaw chuck, which is furnished with either connected jaws (universal) or with independent jaws. They are adapted for use on screw machines, bolt cutters, etc., and for holding drills, square head reamers, and taps, and other tools. They are made to bolt to a face plate, and all have a hole entirely through the chuck. The jaws can be left plain, or made to hold any special piece upon receipt of sample.

Fig. 6 shows a set of reversible face plate jaws. They will be easily understood from the cut. The screws and jaws are made of steel, and the latter can be run out and reversed. As will be perceived, they make a very good independent four-jaw chuck out of a face plate, and are useful on large lathes, boring-mills and drill-press tables. The length of those kept in stock is 10 inches, but other sizes are made to order.

Fig. 7 is a new design of lever scroll chuck. It is furnished with any style jaw desired, of steel, and is made in eight different sizes, from 3 to 21 inches.

Fig. 8 is an amateur's geared scroll chuck, designed for foot lathes and general use. There is only one socket pinion, which projects but little beyond the body of the chuck. They are furnished with any kind of jaws desired, and in two sizes, the two-inch to be fitted either to face plate or taper shank, and the 2½ inch for face plate only.

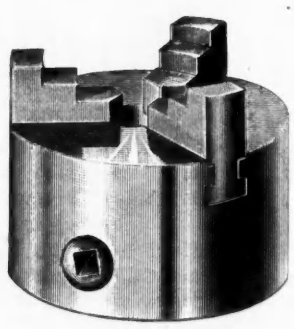


FIG. 8.

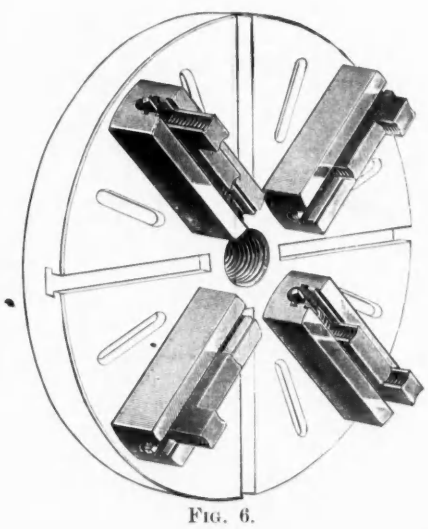


FIG. 6.

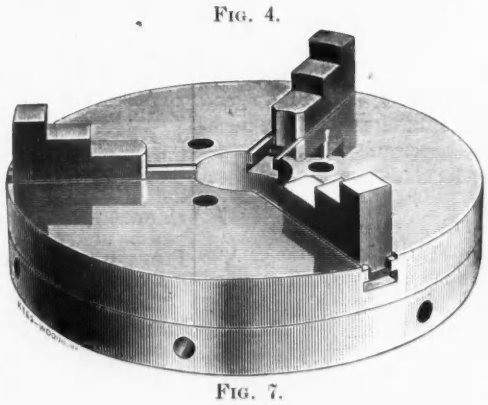


FIG. 7.

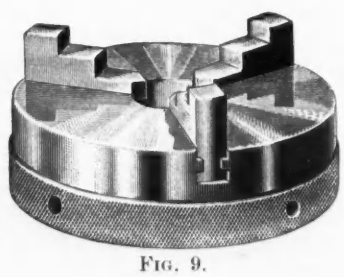


FIG. 9.

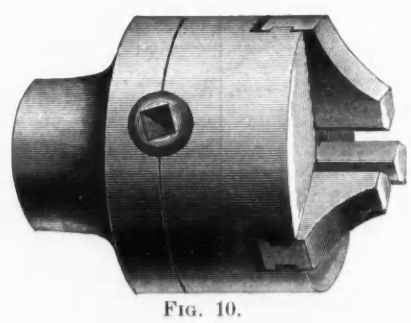


FIG. 10.

NEW PATTERNS OF CHUCKS.

Fig. 9 is an amateur's lever scroll chuck. They are made in four sizes, from two to five inches. The two-inch is made with a hub in which is a taper hole, to which an arbor may be fitted, or can be furnished for a face plate. The other sizes are made for face plate only.

Fig. 10 is a key drill chuck. It has a new style socket pinion, which projects only slightly beyond the body of the chuck; all the working parts are of steel, and interchangeable. The jaws are ground true after tempering. They are made with three styles of jaws, and in two sizes, the smallest having a capacity from 0 to ½ inch, and the larger from ⅛ to ⅝ inch.

The above do not include all the different styles of chucks made by this company, but only such as have been recently brought out, or changed in design. Most of those formerly made have been made stronger by increased weight of the body, and by the use of steel for all jaws, screws and scrolls.

Master Mechanics' Convention Notes.

President Setchel, it is acknowledged on all hands, is a most excellent presiding officer. He speaks sufficiently loud to be plainly heard in every part of an ordinary hall, and he urges the members towards speaking so as to be heard. He disposes of points of order quickly, and clears away any entanglement that may be brought about, in a way to save the time of the association.

By a provision of the new constitution in fixing upon the place for the next meeting, the members vote for as many places as they choose, then the executive committee must select one of the three places for which the most votes were cast. In accordance with this provision, the next meeting will be at Niagara Falls, Montreal or Chautauqua Lake. Previous to this year the members fixed the place for the meeting, and it is not beyond the experience of the association to find that hotel keepers would not redeem the promises in the way of accommodations for the members made a year previous. When the place of meeting was fixed beyond the possibility of change, the committee had nothing to do but secure the best terms it could. Now, with the choice of three places in the hands of the committee, there is little doubt that the memory of hotel keepers will improve wonderfully.

Secretary Sinclair, in his report, called attention to the flattering increase of the membership of the association since the previous annual report. At that time there was a total membership of 277. At the present time there is a membership of 322. During the past year two ordinary members, one honorary member and one associate member have died. There are more than two tons, Secretary Sinclair says, of back reports in his hands, which he has insured in the sum of $2,000. The fourth and sixth reports are exhausted, but there is a good supply of all others except the latest.

The question of the advantage, or otherwise, of the use of feed-water heaters for locomotives was brought before the convention, with a request that those having experience in their use give the results. No one appearing inclined to answer, President Setchel called upon Mr. Paxton, who said, in substance, that it was well understood that there was no advantage in the use of feed-water heaters. This was not disputed, and was evidently the opinion of the members present when the question was asked.

Another question asked related to the effect of the height of boiler on the lateral wear of driving and truck boxes. Mr. Briggs, who asked the question, said he had some ten-wheelers, and he found there was a good deal of lateral wear, and the engines were prone to leave the track. After considerable lateral wear they were all right. He

did not believe, however, that excessive wear was due to the boilers being high. On the contrary, he believed that the lateral wear was less with high than with low boilers. The general opinion appeared to be that high boilers did not increase lateral wear, but that engines were almost invariably put up too tight, then cutting began, and was likely to go on until lateral motion became excessive.

Upon the question of using flanged tires on the front wheels of ten-wheel engines, there was great diversity of opinion, some members expressing themselves as sure of the advantages of doing so, while others were equally positive that blind tires on forward wheels gave superior results. So marked was the difference in opinion in respect to this, that it seems unaccountable, except upon the hypothesis that other conditions were unlike, and that these conditions influenced the results.

The difference in opinion as to the use of rigid or swing trucks on ten-wheelers also showed that there was equally wide difference in opinion, and this difference was between men of large experience. It will evidently take some time to answer these questions conclusively, with the probability that many controlling circumstances will settle the case differently in different instances.

To the question: Is there any known practice safe for dispensing with the use of crown bars? several members expressed themselves as having experience with radial stay bolts, and they had found them better than crown bars. Amongst other things, stay bolts did away with a good deal of the trouble from bad water.

In discussing the report on traction increasers, no one was found defending their use. The best traction increaser, Mr. Barnett thought, was sand, but it should be delivered better than is the usual practice.

In regard to the advisability of admitting air to the extended front of locomotives, Mr. Foster said that, while to do so was contrary to experience and common sense, he was doing so with good results. This arrangement consists of a draft regulator, so called, placed where the hopper is usually located. This regulator is provided with adjustable openings. Some opening is always provided, and when the engine is working hard these openings, aggregating sufficient to supply a five-inch hole, are kept wide open, and this Mr. Foster finds greatly reduces the quantity of cinders drawn through the tubes, the engines steaming very freely. Semi-bituminous slack coal is burned.

Mr. Sinclair thought the law of equivalents could not be set aside; if the matter was carefully investigated some corresponding loss would be found. Opening the nozzles he thought would give better general results and accomplish the same special result.

Questioning brought out the fact that the fire-boxes of Mr. Foster's engines were large.

A question was proposed as to size of water space about the fire-box. Mr. Hickey did not think present practice provided sufficient space.

Mr. Swanton thought the water space should increase gradually from the mud ring up, both for circulation and the free escape of steam. This improves the staying, as it gave larger stay bolts, and these were broken by difference in expansion.

By vote the convention placed itself on record as favoring the use of the brick arch.

Mr. Stevens gave the following figures as the pounds of water evaporated per pound of coal in some experiments conducted by him under the following conditions:

Mackenzie straight stack, 5.70; diamond stack, 5.76; straight stack and extension front, 5.80; straight stack, extension front and brick arch, 7.03.

In discussing hollow stay bolts, Mr. Sinclair thought air over the fire the best preventive of black smoke. Mr. Swanston and Mr. Stevens also spoke in favor of hollow stay bolts.

Officers were elected as follows: President, J. H. Setchel, Dunkirk, N. Y.; vice-presidents, R. H. Briggs, A. T. & S. F. railroad, John Mackenzie, N. Y. C. & St. L. railway, Cleveland, O.; treasurer, George Richards; secretary, Angus Sinclair.

REPORT ON RELATIVE PROPORTION OF CYLINDERS AND DRIVING WHEELS TO BOILERS.

To the President and Members of the American Railway Master Mechanics' Association.

Your committee on boiler proportions beg to submit the following report:

The total heating surface of a boiler should be governed by the horse-power developed when the engine is exerting its maximum continuous effort.

To obtain the most economical results, boilers cannot be designed to suit the many various conditions of service and character of fuel by any hard and fixed rule. For average practice, with bituminous coal, where steam passages are ample, your committee recommend that two square feet of heating surface be provided for each horse-power developed, when engine is exerting its maximum continuous effort.

To arrive at such maximum horse-power, it is suggested that for ordinary passenger and freight engines a piston speed of 800 feet per minute, in connection with 40 per cent. of boiler steam pressure, be assumed; and upon this assumption the following formulæ for engines with 24-inch stroke are submitted:

A. Area of one cylinder in inches multiplied by 5.8 equals total heating surface.

B. Total heating surface divided by 11 equals fire-box heating surface.

C. Total heating surface divided by 70 equals grate area.

D. Total heating surface divided by 400 equals flue area.

It appears that the grate area is capable of a wider range in dimensions than other parts of the boiler, and by making this abnormally large, as in the case of the "Wootten" and other kindred boilers, grades of fuel otherwise of little use can be successfully burned.

With the same size of cylinder, a switching engine requires less heating surface than a road engine, the difference depending upon the special requirements in each case; but the same rule may be applied, viz., to provide two feet of heating surface for each horse-power developed during maximum continuous effort.

Your committee consider that the recent progressive steps in boiler proportions, noticeable in all parts of the country, are largely due to the untiring exertions of your secretary, through the columns of his well-known paper, and information received from him, Mr. J. Davis Barnett and Mr. D. H. Neale have very materially assisted your committee in the preparation of the above report, which is very respectfully submitted by

CHARLES BLACKWELL,
CLEM HACKNEY,
JOHN MCGRAYEL,
Committee.

DISCUSSION.

In discussing this report, Mr. Blackwell said the committee did not wish to have these formulas proposed to be considered as any hard and fast rules, but that they be considered as average quantities and proportions, which can be varied at will either in one direction or other, to suit.

Mr. Barnett said: There are very curious anomalies about our engines—for instance, I take a series of locomotives turned out by one of our large firms within a few weeks of one another. The printed statement said: "That they would haul a given number of tons on a level." Anybody not understanding the situation from our point of view would infer there was some proportion of boiler on these engines to the number of tons they were to haul.

Working out the figures, I found that there was one square foot for a bare ton with one of the passenger engines, and with another, with that same surface—one square foot—it had to haul 1.57 ton.

One freight had one square foot of heating surface for 1.15. Another had 1.27. The Moguls were 1.27 and 2.17.

Another curious anomaly I found in looking up this matter was, that one series reports an engine built and showed this engine to have a maximum horse-power in going down grade.

Mr. Forney thought the subject had been unnecessarily complicated. In his experience he had never found that you can never get the boiler too big; and believed in the maxim which has been stated: "Within the limits of weight and space to which you are confined, you cannot make the boiler too big or the heating surface too great." He continued:

I would make the boiler as big as possible. First determine the size of the wheels, then proportion the cylinder to the wheels. You thus arrive at the weight of the cylinders and the working parts of the engine, and you know what is left for the boiler. When you come to the matter of the relative size of the grate to that of the heating surface, then the matter becomes more complicated. The size of the grate is dependent upon the fuel used.

Mr. Sinclair agreed in a general way with Mr. Forney. As a rule, you can never get the boiler too large. And that is a very good plan he has outlined of designing the cylinders to suit the wheels and then making the boiler as large as possible. But unfortunately that has not been the plan usually followed by our designers. The engineers, or those responsible for track and bridges, have generally said they want the weight on wheels to be kept down within a certain limit. The engine has to be designed to suit this, and the transportation department uses its influence to get as large cylinders as possible. Master mechanics are often induced to enlarge cylinders until they are out of proportion to the boilers, and against their own judgment. The report of the committee here gives about 1,300 square feet of heating surface for a 17″ x 24″ engine. Everyone understands it is a large proportion of heating surface to the cylinder capacity. The aim of the committee evidently is to encourage the designers of locomotives to make as large heating surface as possible, and also as large proportion of boilers to the cylinders as possible. If this is recognized as the standard of the Master Mechanics' Association, then a master mechanic, who may be urged to make a large cylinder and small boiler, can say, "Here is the proportion recommended by the association. You want the engine all out of proportion, and the engine will be expensive to operate." Consequently, I think the adoption of the committee's report will do good to the association, to the interests of the members and their roads generally.

Mr. Forney spoke of the advantage of enlarging the flues. It was difficult to draw air through small and long tubes.

Mr. Mackenzie said their experience was not favorable to large tubes. They had found that 2 inch tubes gave a great deal better satisfaction than 2¼ inch.

Mr. Hickey said: Speaking of the relative efficiency of fire-box and flue heating surface, we have two classes of engines of the same general dimensions, the only exception being that one class of engine has tubes one foot shorter than the other. Those engines are doing the same amount of work precisely—performing the same duty. The engine with the shorter tube makes steam on an average freer than those with the longer tubes. From observation I am prepared to say that the length of the tube does not cut much of a figure in increasing the steaming efficiency of a locomotive, beyond certain limits, of course.

The experiments of Mr. Clark having been referred to, Mr. Barnett called attention to the fact that these experiments were made with coke as fuel.

Mr. Sinclair said that Clark insisted strongly that the deductions from his experiments indicated that a great increase of fire-box surface did not promote the economical working of the engine.

He held that undoubtedly the fire-box surface was more efficient for the generation of steam than the tubes, but the tubes were placed where the greater part of the heat had to be absorbed, and that attention should be directed more closely to make these proportions right, than to efforts to increasing the area of the fire-box unduly.

Personal.

At the end of last month our well-known contributor, Mr. John J. Grant, severed his connection with the American Sewing Machine Co., of Philadelphia, to take a position of responsibility with the Simonds Rolling Machine Co., at Fitchburg, Mass., a change of position and prospects, upon which he is to be congratulated.

During a recent visit to the shops at Philadelphia, of which he has had charge for about two years past, we saw evidences of a great deal of conscientious and skillful work by him in planning and re-arranging their methods of manufacture, the result being apparent in the present admirable arrangements, tools and fixtures which he has introduced for the work, by which the quality of the workmanship has (as we can say from actual comparison) been very greatly improved, and at the same time the cost of production reduced 17.8 per cent., while the men in the shop are making more money than before; an all-round result of which we think any mechanic may be pardoned for taking some pride and satisfaction in. This reduction in cost and improvement in quality would be easily accounted for by any mechanic familiar with such work, who might have an opportunity of seeing the improved machinery, tools and fixtures by which it has been accomplished. They are first-class in every particular, the milling machine fixtures especially (as our readers would naturally expect) being very ingenious and capable of permitting the highest possible degree of efficiency in milling operations. It is safe to say that the system of manufacture started upon there will, if completed as planned by Mr. Grant, make the shops second to none in point of equipment and facilities for economical manufacturing.

F. B. Shaffer, known to our readers as an occasional correspondent and recently foundry foreman at the Best Steam Engine Works, Lancaster, Pa., has accepted a similar position at the works of F. M. Davis, Denver, Col.

The Pennsylvania Railroad officials conceived the idea a few days ago that an entire locomotive could be built in less than twenty-four hours, the best time on record, which was made by the Baldwin Locomotive works, of Philadelphia. Accordingly work was begun on Monday morning last in the shops at Altoona. Twenty hours was the given time. In sixteen hours and fifty-five minutes the engine was completed and turned out of the shops ready for use. It is a class A anthracite, weighing 110,000 pounds, and will be used in the New York division of the Pennsylvania Railroad.—*American Manufacturer.*

This performance has started a lot of items through the papers similar to the above, and no doubt they will be very interesting to many who read them, but, unfortunately, they are not true. We are not surprised at seeing a newspaper publish such a statement, but it is surprising that a mechanical paper, supposed to be posted on shop matters, should publish such items.

A locomotive cannot be *built* in twenty hours, and there is one part of a locomotive, *i. e.*, the boiler, which cannot be built in much short of that many days of ten hours each, and there are many other parts of a locomotive which cannot be finished in anything like twenty hours.

Where locomotives are built upon the interchangeable plan, each part being made to standard gauge, it is perhaps possible to assemble those parts properly within twenty hours, provided the boiler, frames, and some other parts are previously made. But assembling a locomotive is not building one by any means, and we very much doubt

if any locomotive has ever really been *built*—the castings, forgings, boiler and all included—in less than three weeks.

We like to read interesting mechanical items, but we prefer them to be accurate and true.

Some Points About Levels.

BY FRED J. MILLER.

The publication in the AMERICAN MACHINIST of April 28th, of Jarno's cut and description of a good spirit level, has awakened some interest in the subject of good levels, and it is evident that a good many mechanics have a very vague idea respecting the principle upon which they act, and as to why one level should be better than another. A good many seem to think that the sensitiveness and accuracy of a level depend principally upon the fluid with which it is filled, those filled with an inferior fluid being sluggish and slow, while those which are filled with something better are quicker and more sensitive.

If a common level glass, such as can be had at the hardware stores, and is sold to carpenters and builders, to replace their broken ones, be examined, it will be found to be, not straight, but curved, and it is only by so mounting it as to bring the convex side upwards, that leveling can be done with it.

Alcohol is almost exclusively used as a fluid, for both the common and the better class of levels. The bulb is not quite filled, and the air which is left in it, and constitutes the bubble, finds the highest place in the bulb or glass, simply because it is lightest, and the action of gravitation causes the alcohol to take the lowest place. What is meant by the highest place in the bulb is, in fact, the place which is furthest from the center of the earth, and if the bulb be mounted in the frame with its convex side uppermost, and the bubble of air brought to the middle, it simply indicates that the two ends of the bulb have been brought to an equal distance from the center of the earth, and if at the same time the glass is so mounted in the frame that its two ends are at an equal distance from the face of the frame by which the leveling is done, then the surface or object upon which it is resting is said to be level. As a matter of fact, however, a level line is not a straight line, but is a curved line, which is everywhere equi-distant from the center of the earth.

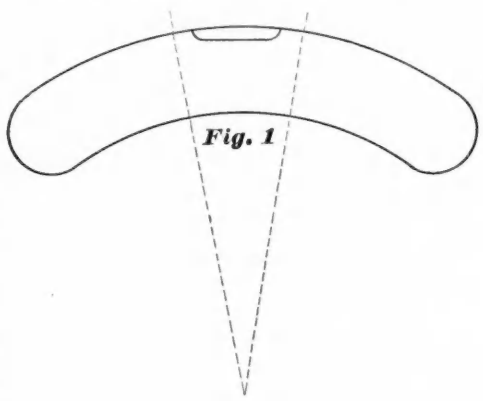


Fig. 1

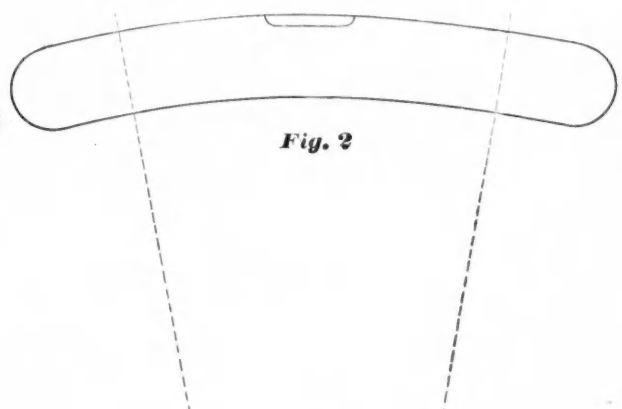
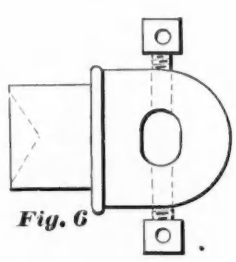


Fig. 2



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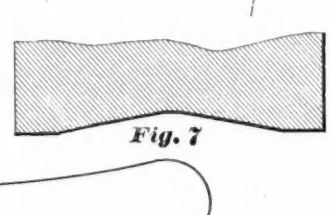

Fig. 7

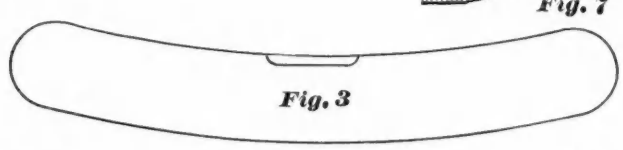

Fig. 3

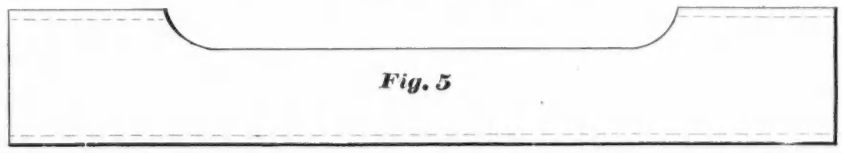

Fig. 5

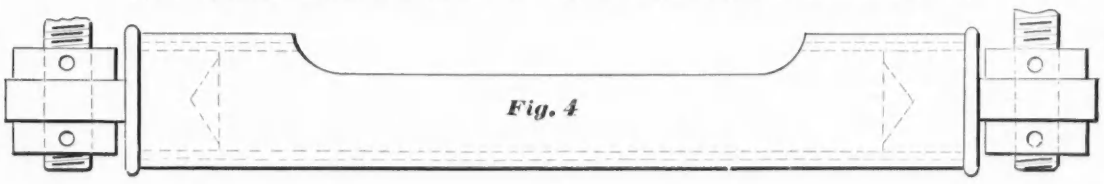

Fig. 4

The sensitiveness and accuracy of a spirit level depend chiefly upon the amount of curvature given to the glass. The reason will be apparent upon inspection of Figs. 1 and 2, which represent level glasses having different degrees of curvature. Both of these have far more curvature than is ever given to any good level, however.

The dotted converging lines, Fig. 1, are at an angle with each other of 20 degrees, and it is plain that to move the bubble from one to the other of these dotted lines the glass would require to be tipped through an angle of 20 degrees; or that, supposing the bubble to be in the center of the glass, as it is shown, it would be necessary to elevate or depress one end of the glass through an angle of 10 degrees, in order to move the bubble to one or the other of the dotted lines. In Fig. 2 the dotted lines are drawn at the same angle to each other, but, owing to the greater radius of the curve, the distance between them, where they intersect the glass, is greater, and the level is correspondingly more sensitive, since it is evident that if one or the other of the ends of this glass be elevated or depressed ten degrees the bubble will move from its present position to one of the lines; which is a greater distance than is the case with Fig. 1.

It is thus made plain that the same amount of elevation or depression in the two cases, would cause a much greater movement in Fig. 2 than in Fig. 1, and that the sensitiveness of a level, other things being equal, will be in proportion to the radius of its curvature. If a level glass were made, having a curvature corresponding to that of the surface of the sea, an elevation of ten degrees in such a glass would cause a movement of bubble of about 700 miles, if it failed to reach the end of the glass within a shorter distance. The curvature is given to the common glasses by bending them in the blowing, but in the case of the finer ones they are ground inside to a certain definite and very slight curve. This is done usually by the use of an arbor of copper or other soft metal, turned to the proper curvature and charged with grinding material and water or oil. The arbor is revolved in a lathe or otherwise and the glass put over it and manipulated by the hand, until the inside is ground out to a curve conforming to that of the arbor. Finer grinding material is used to finish with, and pains are taken, not only to have only a slight curvature, but a very regular and uniform one from end to end of the glass, and also to have the inside quite smooth. They are then filled with alcohol or ether and closed by the blow pipe, except in the case of the very finest ones used for certain purposes in connection with astronomical instruments, which are sealed by other means, without the necessity for heating the end of the glass, and the consequent risk of distortion or breakage. Levels of this grade are often provided with an auxiliary chamber connected with the glass, and also filled with the fluid and so arranged that, by turning a milled head screw, more or less pressure can be put upon the enclosed fluid and air bubble, which latter is thus kept to a uniform length, notwithstanding changes in temperature, from which cause, by contraction and expansion of the fluid, the air bubble is continually being more or less compressed and its length altered.

I do not know to what extent the refinement of curvature has been carried in grinding the glasses, but I have seen them in which a movement of the bubble from one graduation to the other (which were about $\frac{3}{16}$" apart) indicated an elevation of one second of arc, and, of course, it was easy to read by estimation to half seconds.

There is a rumor according to which they have been ground to the curvature of the earth's surface, but this is probably not true—one good reason for disbelieving it, if there were no other, being that such a level would be useless, because when placed level it would be everywhere equi-distant from the earth, and there would be no highest place in it; the bubble consequently would stay anywhere in the glass with indifference.

It is also evident from this that a glass made straight, or curved the opposite way, as in Fig. 3, would never indicate a level, because, if the bubble were in one end, that end would require to be depressed considerably below the other before the bubble would start to move, but when it did start it would move to the other end without stopping. Levels are sometimes met with which act in that way, and that is always the cause of the trouble.

At a slight additional expense glasses can be obtained with the graduations made on the glass itself, which I think is preferable to having an independent metallic scale above the glass.

It will be seen from the above that a good level glass must necessarily be somewhat expensive; but when one is obtained and properly mounted it will prove to be a very satisfactory tool, and after using such a one a good mechanic would scarcely be satisfied to use some of the tools which are by courtesy called levels.

In Fig. 4 is shown an arrangement for the mounting, which is probably the best. It is substantially the plan generally pursued in mounting levels upon civil engineers' leveling instruments. It consists of a piece of tubing (Fig. 5) large enough to take the glass in easily, and having a gap cut out of one side for the bubble to show through. In each end is fitted a piece, shown at Fig. 6, except that only one of them has the elongated hole and side-adjusting screws, the other having a round hole to fit the stud.

For use in the shop it would probably be safest to put on an extra tube over the other one, as shown in Fig. 4. This outer tube has an opening cut in it, to correspond with the inner one, on which it fits closely, but so as to allow of being turned round by the fingers. Then, when the level is not in use, the outer tube can be turned half way round and the glass is completely covered and protected from any accidental injury. The end pieces should fit snugly into the inner tube, and may be secured by small screws.

It often becomes necessary to level a shaft or other cylindrical object in the shop, and for this reason I think it is preferable to make the face of the level frame of the shape shown in Fig. 7.

In leveling a shaft with a level having a plain flat face it is difficult to know when the level is straight with the center of the shaft, and if it be held at a very slight angle to it, it is possible, by tipping the level slightly sideways, to make the shaft appear level, whether it is so or not. But by making the face as shown in Fig. 7, it always lines itself perfectly when placed upon a cylindrical surface, and by means of the side-adjusting screws shown in Fig. 6, any error which might arise from tipping the level slightly to one side or the other can be provided against. The error which arises in this way is caused by the fact that it is impossible to so mount a glass in the tube, and the tube in the frame, that the central line, or axis of the glass, will exactly coincide with or be parallel to the center line of the frame; and after the glass has been put in, and fastened by plaster of paris at each end, as it should be, it is not easy to change it. To remove the error is the object of the side-adjusting screws, and to make the adjustment, place the level upon a true cylindrical surface, bring it to a level, and then tip it to one side; if the bubble moves towards either end it is in need of lateral adjustment, and by loosening one of the side-adjusting screws, and tightening the other, it can be adjusted so that tipping sidewise will not affect it, and it is then in perfect adjustment, so far as that is concerned. The other adjustment, to bring the glass parallel with the face of the frame, is effected by turning the four nuts which screw onto the studs, as shown, until the level can be reversed end for end, and show true.

In engineers' instruments all these parts are made of brass, but this is chiefly because they cannot use any metal which has an effect upon the magnetic needle, and there is no reason why, if one should prefer it, they could not be made of steel; it would be a better protection to the glass in the shop, and would look better. It also improves the appearance to put a piece of white or bright colored paper in the tube under the glass.

It is to be hoped, as Jarno says, that some such a level is to be placed upon the market; of course it would cost much more than those now commonly used, but, like a great many other first-class tools, it will be found well worth the additional expense to those who occasionally wish to know whether a thing is really level or not.

There is a popular belief that poets are born, not made, but such is evidently not the case with rhymers, because we notice the advertisement of a manufacturing concern, in one of our London exchanges, in which it is stated that they make them, "patent twist" ones. A picture of one of them is shown; it looks very much like what we should call a reamer.

Length of Belts.

BY J. G. A. MEYER.

FIRST PAPER.

In practice it is often necessary to determine the correct length of an endless belt used for the purpose of transmitting a continuous rotary motion from one shaft to another.

The purpose of this article is, in response to inquiries from a number of our readers, to explain in as simple a manner as possible, how the lengths of belts can be determined.

For the transmission of a continuous rotary motion, from one shaft to another, one of the two following arrangements of belts is used, namely, the open belt, such as shown in Fig. 1, and the crossed belt, such as shown in Fig. 2. Consequently this subject may be divided into two divisions, the first including the rules and methods for determining the lengths of open belts; and the second including the rules and methods for determining the lengths of crossed belts. For the sake of simplicity we shall, at present, leave the thickness of the belts out of consideration.

Open Belts, Fig. 1.—Let the line $A\ B$ represent the distance between the centers of two given pulleys; A being the center of the pulley $f\ g\ h\ e$, and B the center of the pulley $l\ m\ n\ w$; it is required to find the length of an open belt passed over these two pulleys.

Assuming that there is no sag in the belt, we may say that all belts are composed of two parts; namely, first, the sum of the straight parts $g\ l$ and $h\ m$, which do not touch the pulleys; second, the sum of the curved parts $g\ f\ h$ and $l\ m\ n$; that is, those parts of the belt which are in contact with the pulleys.

Now, since we have to deal with two distinct parts of a belt, namely, the straight part, and the curved part, we must know the exact positions of the points which separate, or in which the curved and straight parts of the belt terminate. These points of separation are represented by the points g, h, l, m, and are the most important points in our calculations.

The position of these points we shall first find by a geometrical construction. Such a course will not only make this subject plainer, but will also enable us to understand the principles upon which the calculations of the length of belt, are based.

On the line $A\ B$ lay off a point c midway between the centers A and B; from the point c as a center, and with a radius equal to $c\ A$, or $c\ B$, describe the semi-circle $A\ s\ B$. Through the centers A and B, draw the diameters $d\ e$ and $k\ j$ perpendicular to $A\ B$. On the diameter $d\ e$, and from its extremity d, lay off towards the center A, a point r; the distance between the points d and r must be equal to the radius $B\ k$ of the small pulley. From the center A, and with a radius equal to $A\ r$, describe a short arc cutting the semi-circumference $A\ s\ B$ in the point i; through the points A and i draw a straight line, and produce it so as to cut the circumference $f\ g\ h\ e$ in the point g, also join the points i and B by a straight line. Now, because the angle $A\ i\ B$ is inscribed in a semi-circle, it must be a right angle; or, in other words, the line $A\ i$, and consequently the line $A\ g$, must be perpendicular to, or square with the line $i\ B$. Through the center B draw a line $B\ l$ perpendicular to the line $B\ i$, and cutting the circumference $l\ m\ n$ in the point l. Join the points g and l by a straight line $g\ l$. This line $g\ l$ is tangent to the two circles, because it is perpendicular to the lines $A\ g$ and $B\ l$, and touches the circles in the points g and l, and these points are the only two points in which the straight line $g\ l$, even if this line is extended either way, can touch the circles $f\ g\ h\ e$ and $l\ m\ n\ w$; any other point in the line $g\ l$ cannot touch the circles. Therefore the points g and l are the points which separate the straight part of the belt from its curved part above the center line $f\ n$. We may also state here, that the line $g\ l$ represents one of the straight parts of the belt.

The points h and m can be found in a manner precisely similar to that adopted for finding the points g and l. But since the arc $e\ h$ will be equal to the arc $d\ g$, and $j\ m$ equal to $k\ l$, we may employ a simpler method for finding the points h and m. Thus: From the point e as a center, and with a radius equal to the distance between the points h and g, describe a short arc cutting the circumference $e\ d\ f\ e$ in the point h, and thus making the arc $e\ h$ equal to the arc $d\ g$; the point h will be one of the points sought. From the point j as a center, and with a radius equal to the distance between the points k and l, describe a short arc cutting the circumference in the point m, making the arc $j\ m$ equal to the arc $k\ l$; the point m will be another point sought. We have now established the positions of the points g, l, h, m, which separate the straight portions of the belt from the curved portions.

Some of our readers may have an idea that this construction is unnecessary, and that the same result may be obtained by simply drawing a line $g\ l$, which will touch the two circumferences of the pulleys, and then mark off the points g and l, in which the line $g\ l$ appears to touch the circles. Such a course will not give results sufficiently accurate, particularly when the diameter of one of the pulleys is comparatively large; neither will such a method help us to establish rules for calculating the length of the belt, as we shall presently show.

Now, having established the position of the points g, h, l, m, we have greatly simplified our problem, and reduced it to two very simple ones, namely, first, to determine the length of the line $g\ l$, and second, to determine the lengths of the arcs $g\ f\ h$ and $l\ n\ m$. Furthermore, having the geometrical construction for finding the points g, h, l, m, before us, there should not be any difficulty in understanding the principles upon which the following calculations are based; which, although necessarily somewhat lengthy, are perfectly simple.

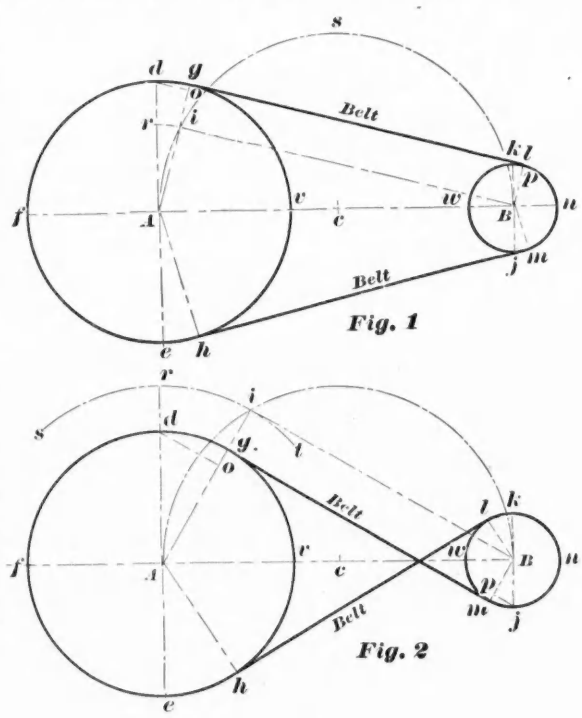

Fig. 1

Fig. 2

LENGTH OF BELTS.

In taking the following example our subject will appear still plainer; hence:

Fig. 1. The diameter of the large pulley $f\ g\ h$ is 22 inches; the diameter of the small pulley $l\ m\ n$ is 8 inches; the distance between their centers A and B is 30 inches; it is required to find the length of an open belt passing over these pulleys.

The distance between the center A and B in our example, is closer than found in practice; but this short distance between the centers of the pulleys suits our purpose of pointing out more clearly the geometrical principles involved, than can be done with a longer distance. This will in nowise detract from value of the rules, for that which is true in the case before us is also true for any other case in which the distance between the pulleys is greater.

Let us first find the length of the line $g\ l$.

The line $g\ l$ is parallel to the line $i\ B$, because by construction the line $g\ i$ is parallel and equal to the radius $B\ l$ of the small pulley. The length of the line $g\ l$ is equal to the length $i\ B$, because both lines are terminated by the parallel lines $g\ i$ and $B\ l$. Again, because the chords $i\ A$ and $i\ B$ are drawn to the extremities of the diameter $A\ B$, the triangle $A\ i\ B$ thus formed is a right-angled triangle (see AMERICAN MACHINIST, Practical Drawing, Art. 108). Hence to find the length of the line $g\ l$ we have simply to find the length of the side $i\ B$ of the right-angled triangle $A\ i\ B$. The length of this line is found according to rules given in elementary geometry; thus, subtract the square of the side $A\ i$ from the square of the side $A\ B$, and find the square root of the remainder, which will be the required length $i\ B$. We know the length of $A\ B$ is equal to 30 inches; the length of $A\ i$ is equal to 7 inches, because by construction it is equal to the differences of the radius of the large pulley and that of the small pulley. Hence we have, the square of $A\ i = 7 \times 7 = 49$, the square of $A\ B = 30 \times 30 = 900$, and the square root of the difference of these squares will be equal to the length of the line $B\ i$; hence we have

$$\sqrt{900 - 49} = 29.17 \text{ inches},$$

which is the length of the line $B\ i$. But we have already seen that $B\ i$ is equal to $g\ l$, consequently the length of $g\ l$ is equal to 29.17 inches. Again $g\ l$ is equal to $h\ m$, therefore the whole length of the straight part of the belt will be equal to $29.17 \times 2 = 58.34$ inches. From the foregoing we can establish the following rule:

Rule 1.—To find the length of the straight part of an open belt. From the square of the distance in inches between the centers of the pulleys, subtract the square of the difference of the two radii of the pulleys in inches, and find the square root of the remainder; the product obtained by multiplying this square root by 2 will be the length of the straight part of the belt; that is, the sum of $g\ l$ and $h\ m$ in Fig. 1.

Rules of this kind are more convenient for use when they are given by symbols, which may be done in the following manner:

Let S represent the straight part of the belt in inches; that is, the sum of the line $g\ l$ and $h\ m$; L the distance in inches between the centers A and B of the pulleys; R the radius in inches of the large pulley; and r the radius in inches of the small pulley, then:

$$S = 2\sqrt{L^2 - (R - r)^2}$$

Now let us find the lengths of the arcs $g\ f\ h$ and $l\ n\ m$, or in other words the length of the curved part of the belt. In order to do so, we must first find the lengths of the arcs $d\ g$ and $k\ l$. It can be easily proved that each of the angles $g\ A\ d$ and $l\ B\ k$ is equal to the angle $A\ B\ i$.

Consequently, if we know the number of degrees in the angle $A\ B\ i$, we also know the number of degrees in each one of the angles $g\ A\ d$ and $l\ B\ k$.

The number of degrees in the angle $A\ B\ i$ is found by the following method, based upon the principles of trigonometry.

In the first place we find the sine of the angle $A\ B\ i$ by

Rule 2. For open belts; divide the difference of the radii of the two pulleys (that is the line $A\ i$) by the distance between the centers of the pulleys (that is the length of the line $A\ B$); the quotient will be the sine of the angle $A\ B\ i$.

We may represent this rule by symbols; remembering that the line $A\ i$ is the difference between the radii of the two pulleys, we have

$$\frac{R - r}{L} = \text{sine of the angle } A\ B\ i.$$

Where R = radius of large pulley in inches.
" r = radius of small pulley in inches.
" L = distance between the centers of pulleys.

Now, substituting numerical values for the symbols, we have

$$\frac{11 - 4}{30} = 0.233 = \text{sine of angle } A\ B\ i.$$

Referring to a table of natural sines and tangents, which can be found in any good engineer's pocket book, we find that an angle whose sine is 0.233 contains 13 degrees and 30 minutes (very nearly).

But the angle $d\ A\ g$ is equal to the angle $A\ B\ i$, hence, the angle $d\ A\ g$ also contains 13 degrees and 30 minutes.

One degree is equal to $\frac{1}{360}$th part of a circle, and an angle of one degree is subtended by an arc equal to $\frac{1}{360}$ part of the circumference. Consequently for finding the length of the arc $d\ g$ we have the following:

Rule 3.—Multiply the whole circumference of the pulley in inches by the number of degrees in the angle $A\ B\ i$, and divide this product by 360, the quotient will be the length of the arc $d\ g$.

The circumference of the pulley 22 inches diameter is equal to 69.1152 inches, hence we have

$$\frac{69.1152''}{360} \times 13.5 = 2.59 \text{ inches},$$

which is the length of the arc $d\ g$, and also the length of the arc $e\ h$. By the same rule we can find the length of the arc $k\ l$. Remembering that the angle $k\ B\ l$ is equal to the angle $A\ B\ i$, and that the circumference of the small pulley is 25.1328 inches, we have

$$\frac{25.1328}{360} \times 13.5 = 0.94 \text{ inches},$$

which is the length of the arc $k\ l$, and also the length of the arc $j\ m$. But the arc $g\ f\ h$ is equal to the sum of the arcs $d\ g$, $e\ h$ and the semi-circumference of the large pulley. The semi-circumference is equal to

$$\frac{69.1152}{2} = 34.5576.$$

Therefore,

$$34.5576 + 2.59 + 2.59 = 39.7376 \text{ inches},$$

which is the length of the arc $g\ f\ h$, or that portion of the belt which is in contact with the large pulley.

The length of the arc $l\ n\ m$ is equal to the semi-circumference of the small pulley, minus the sum of the arcs $k\ l$ and $j\ m$. The semi-circumference of the small pulley is equal to

$$\frac{25.1328}{2} = 12.5664 \text{ inches},$$

hence

$$12.5664 - (0.94 + 0.94) = 10.6864 \text{ inches},$$

which is the length of the arc $l\ n\ m$, or that portion of the belt in contact with the small pulley.

Now, the curved portion of the belt is equal to the sum of the two arcs $g\ f\ h$ and $l\ n\ m$, consequently it is equal to

$$39.7376 + 10.6864 = 50.4240 \text{ inches};$$

the straight part of the belt is, as previously found, equal to 58.34 inches, therefore the whole length of the open belt will be equal to

$$50.4240 + 58.34 = 108.7640 \text{ inches}.$$

It is proposed to construct a canal from London to Birmingham which will admit of barges of 300 tons burden being loaded in the Thames from vessels, taken through the canal by steam power, and unloaded at wharves connected with the various industrial establishments.

Iron, in an article upon the subject, argues that it would be a great advantage, and that goods could be transported from London to Birmingham or *vice versa* at a little more than half the present rate, and that, "through water communication between the sea and the principal inland centers of industry has become a matter of imperative necessity. That it should have done so, our railway companies have themselves very much to thank for. Considering the comparatively short distances that separate the midland towns from good seaports, we think we may assert that it has been within their power so to deal with the traffic of the country as to have prevented any dissatisfaction on the part of traders. But they have not done so. They have chosen to ignore the obligations which they are under towards the commerce of the country, in virtue of the practical monopolies conferred upon them by parliament, and have come to regard it as something which it is their particular privilege to prey upon."

Notes on the Expansion of Steam.

BY RICHARD H. BUEL.

SIXTH PAPER.

An examination of line 57 of the table published in the last article will show that the probable consumption of steam hourly per effective horse-power is approximately the same for the two cases where the apparent cut-off is $\frac{1}{8}$ and $\frac{1}{4}$ respectively; and that when the cut-off is either lengthened or shortened beyond these points, the probable steam consumption increases rapidly. As is well known, the usual practice of builders of automatic non-condensing engines is to base the power of their machines upon a definite piston speed, and different initial pressures of steam, cut-off at $\frac{1}{4}$ stroke. If the table is correct, this is a judicious system of rating; because the work of a factory in which a new engine is erected is more liable to be increased, in the course of time, than to be diminished, and if a cut-off of $\frac{1}{4}$ gives sufficient power at first, the load of the engine can be increased up to a cut-off of $\frac{1}{3}$, without materially affecting the economy of operation. A calculation of the results obtained by changing the cut-off from $\frac{1}{4}$ to $\frac{1}{3}$ will be useful in showing the application of the general formulas to changed conditions. The problem now is to find the probable effective horse-power and probable steam consumption of the engine designed to develop 150 effective horse-power at a cut-off of $\frac{1}{4}$, when the cut-off is lengthened to $\frac{1}{3}$ stroke, the piston speed and initial pressure being unchanged. In the following calculation the proper values are substituted in the formulas of the table, the reference number of the formula being given in each instance. When the necessary data are unchanged by the change of cut-off, they are simply taken from the table, and where the changed conditions alter the results, the calculations are presented in detail, the proper numbers being substituted for the letters in the formulas.

The data, as given by the table, and the calculated results, are presented below.

Formula.

2. $P = 100$ pounds per square inch.
3. $b = 17.5$ " " " "
4. $1/r = .33$
5. $C = 96.5$ pounds per square inch.
9. $V = 450$ feet per minute.
10. $m = 98.25$ pounds per square inch.
11. $r = 3$
19. $e = 3\frac{1}{4}$ per cent.
20. $R = \dfrac{1 + .0325}{.33 + .0325} = 2.823$
21. Hyp. log. $R = 1.0378$ (From tables.)
22. $M = \dfrac{98.25 + 96.5 \times 1.0378}{2.823} - 17.5$
$= 52.8$ pounds per square inch.
23. $n = 52.8 - .0325 \times (100 - 52.8)$
$= 51.3$ pounds per square inch.
24. $l = 2.823$
26. Hyp. log. $l = 1.0378$ (From tables).
27. $L = 17.5 \times 2.2823 = 49.4$ pounds per square inch.
28. $k = 49.4 \times \dfrac{1.0378}{1.823} = 28.1$ pounds per square inch.
29. $t = 51.3 - .0325 \times 1.823 \times (28.1 - 17.5.)$
$= 50.7$ pounds per square inch.
30. $e = .95 \times 50.7 = 48.2$ pounds per square inch.
35. $s = 38$ inches.
38. $(q) = 278.9$ square inches.
39. $(E) = \dfrac{48.2 \times 278.9 \times 450}{33{,}000} = 183.3$ effective horse-power
41. $N = .199$ cubic foot.
42. $v = 6.026$ cubic feet.
43. $u = 8526$ strokes per hour.
44. $B = \dfrac{.33 + .0325}{.95 + .0325} = 35.9$ pounds per square inch.
45. $W = .08784$ pound. (From tables.)
46. $w = .11857$ pound. (From tables.)
47. $Q = 8526 \times (6.026 \times .08784 - .199 \times .11857) = 4212$ pounds.
48. $U = 96.5 \times \dfrac{1.0378}{1.823} = 54.9$ pounds per square inch.
49. $I = \dfrac{54.9 \times 2}{3 \times (51.3 + 17.5)} = .532$
50. $i = \dfrac{(51.3 + 17.5) \times .532 \times 278.9 \times \frac{8}{12} \times 8526}{772}$
$= 366491$ British thermal units.
51. $(l) = 932$ British thermal units. (From tables.)
52. $(C) = \dfrac{366491}{932} = 393$ pounds.
55. $(d) = 518$ pounds.
56. $(w) = 4212 + 393 + 518 = 5123$ pounds of steam hourly.
57. $(W) = \dfrac{5123}{183.3} = 27.9$ pounds of steam hourly per effective horse-power.

By carefully following the preceding calculations and comparing them with the formulas of the general table, the manner of using these formulas will probably be made clear to all readers who are familiar with arithmetical operations. The attempt has been made in arranging the formulas to have them perfectly general in form and at the same time as simple as possible, and thus popularize an important problem, which is usually presented in a more complicated manner. The above calculation, it will be noticed, differs from the calculations of the general table; the general calculation being directed to the determination of the proportions of engines for fixed conditions, while, in the other computation, some of the governing conditions of an existing engine are changed. It is not unlikely that the proportions calculated in the general table might be advantageously changed in several instances, and this can be determined by trying the effect of changes in the cut-off, initial pressure or piston speed. The reader will find it useful to compute results for changed conditions by the method detailed in the present article. It is not probable that any material decrease of steam consumption can be effected, without increasing the initial pressure or the piston speed; for it is believed that the figures in line 57 of the table represent about as good results as are attainable under the assumed conditions. But they are by no means the best results which can be expected from non-condensing engines at the initial pressure, points of cut-off and piston speed assumed. Line 56 shows that the probable steam consumption is made up of three items, viz.:

1. The steam used as measured by the piston displacement (line 47). This can only be reduced by increasing the volume or reducing the terminal pressure of the steam.

2. The steam condensed for the work during expansion (line 52.) This of course increases rapidly with increased expansion and the editor of a technical paper, who apparently does not appreciate this fact, recently remarked that the great amount of water found in the exhaust of marine engines at very short cut-off, might possibly be caused by the excessive priming of the boilers. If the mechanical theory of heat is correct, this condensation must take place, but it is possible to prevent the formation of water in the cylinder by attaching an efficient steam jacket, or by superheating the steam.

3. The steam condensed by radiation and conduction (line 55.) This can be materially decreased by preventing the formation of water in the cylinder.

The methods just mentioned of decreasing steam consumption will now be considered in detail; the effect of steam jackets being first discussed.

A Young Machinist Tries His Hand at Making a Telescope.

The Pittsburgh *Commercial Gazette* says:

Some time ago a young man, who had but recently graduated from the Pittsburgh High School, called upon Mr. Brashear (maker of the spectroscope for the Lick Observatory) for some information in regard to the construction of a telescope. His name is Sherman Buvinger, and he was at that time a machinist in McIntosh, Hemphill & Co.'s iron works. In his spare moments he engaged in the scientific work of making a telescope as large as those in use by the majority of astronomers. It took him a long time to do it. The first lenses he ground were failures. He tried it again and the result was successful. He manufactured complete a six-inch telescope. When it is remembered that a four-inch instrument will give a wonderful glimpse of the heavens, the power of young Buvinger's telescope can be comprehended. With it he was able to see all the moons of Saturn, and his glass resolved many nebulæ which bothered astronomers with smaller telescopes.

Cranks.

Considerable ingenuity has been wasted at different times, and by different individuals, in efforts to find a substitute for the crank, under the impression that the crank, as used upon engines and other machinery, is somehow prodigiously wasteful of power; but the crank has continued to prove its usefulness.

There is another species of crank who comes in for a good deal of abuse, respecting which variety, the following words of Robert J. Burdette contain considerable philosophy and some food for thought:

"What would we do were it not for the cranks? How slow the tired old world would move, did not the cranks keep it rushing along! Columbus was a crank on the subject of American discovery and circumnavigation, and at last met the fate of most cranks, was thrown into prison and died in poverty and disgrace. Greatly venerated now! Oh, yes, Telemachus, we usually esteem a crank most profoundly after we starve him to death. Harvey was a crank on the subject of the circulation of the blood; Galileo was an astronomical crank; Fulton was a crank on the subject of steam navigation; Morse was a telegraph crank. All the old abolitionists were cranks; the Pilgrim Fathers were cranks; John Bunyan was a crank; and any man who doesn't think as you do, my son, is a crank. And, by-and-by, the crank you despise will have his name in every man's mouth, and a half-completed monument to his memory crumbling down in a dozen cities, while nobody outside of your native village will know that you ever lived. Deal gently with the crank, my boy. Of course some cranks are crankier than others, but do you be very slow to sneer at a man because he knows only one thing and you can't understand him. You thank Heaven you are not a crank. Don't do that, my son. Maybe you couldn't be a crank if you would. Heaven is not very particular when it wants a weather-vane; almost any man will do for that. But when it wants a crank, my boy, it looks very carefully for the best man in the community. Before you thank Heaven that you are not a crank, examine yourself carefully, and see what is the great deficiency that debars you from such an election."

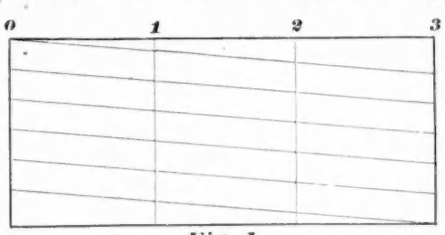

Fig. 1

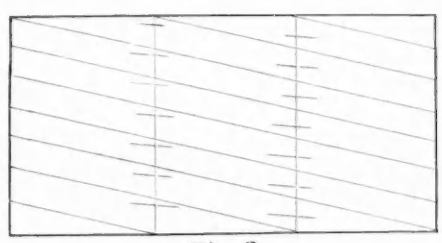

Fig. 2

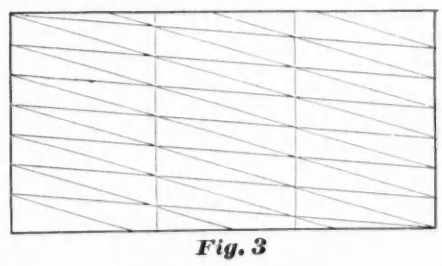

Fig. 3

THAT ERRATIC TAP.

The Springfield *Republican* says: "Roast beef and beefsteak may now be classed as luxuries. The local market men last week raised the price of beef three cents a pound. The price of steers has increased in three weeks by $20. The cause is that 'the big four,' Armour, Swift, Hammond and Nelson Morris, the beef monopolists of Chicago, have bought up all the cattle on nine-tenths of the western cattle ranches, and have seen fit to spring the trap now. As usual, the poor people will have to suffer for the greed of gamblers."

LETTERS FROM PRACTICAL MEN.

That Erratic Tap.

Editor American Machinist:

I suppose I am in as good a position as any one to offer an explanation of the action of J. P. L's runaway tap in the AMERICAN MACHINIST, June 16, I having lately encountered a similar experience. We were tapping a lot of cast-iron nuts in the bolt cutter with a tap having 4 flutes. The operator crowded some of the nuts too hard upon the tap in starting, and we found that several of them were tapped with five threads instead of one. I came to the conclusion that the action of the tap was correct, and I would advise J. P. L. to do the same. With the perversity of inanimate things, the tap with eight cutters could not and would not cut eight threads, however intense might be the theory as to the propriety of its doing so. That the tap in starting happened to strike the right lead to cut the nine threads may be considered a lucky accident. Cutting any number between one and nine, the several cutters would each be in a position to cut away or destroy some part of the thread which any other of the cutters would be in a position to form.

The tap having eight cutters and $\frac{1}{10}''$ pitch, the linear advance of any cutter would be $\frac{1}{8}$ of $\frac{1}{10}''$; or $\frac{1}{80}''$ before the next succeeding one. Starting then from any cutter, the successive advances would be:

$$0 - \tfrac{1}{80} - \tfrac{2}{80} - \tfrac{3}{80} - - - - - - - \tfrac{8}{80},$$

the last one being the whole pitch in advance, and following accurately into the next thread when cutting a single thread. To cut eight threads, as J. P. L. seems to assume the tap should, the linear advance required at each $\frac{1}{8}$ of the circumference would be eight times the advance for a single thread:

$$0 - \tfrac{8}{80} - \tfrac{16}{80} - \tfrac{24}{80} - - - - - - - \tfrac{64}{80}.$$

But $\frac{8}{80}''$ or $\frac{1}{10}''$ is the actual pitch, and at each $\frac{1}{8}$ of the circle the thread coincides with the next thread, with no advance. To make the tap coincide with this, we must add to it the advance of the successive cutters of the tap. We then get:

$$0 - \tfrac{9}{80} - \tfrac{18}{80} - \tfrac{27}{80} - - - - - - - \tfrac{72}{80}.$$

This is 9 times the pitch, and the tap coming to these successive positions as it advances will cut 9 threads.

If we take a simpler case, say a single thread tap with 3 cutters and $\frac{1}{8}''$ pitch, we can represent the conditions by a little sketch as given. We assume the interior of the tapped hole to be unrolled or produced, the figure representing the whole circumference of the thread cut; 1, 2, 3 indicating the positions of the 3 equidistant cutters, and 0, of course, being identical with 3. Fig. 1 is a diagram of a single thread, Fig. 2 of a triple thread, Fig. 3 of a quadruple thread. It will be seen, Fig. 2, that if we place one cutter of the single thread tap to coincide at 0-3, of the triple thread, the other cutters will not coincide at 1 and 2. But with the quadruple thread, Fig. 3, all the cutters coincide, and the single-threaded tap with 3 cutters cuts four threads. We may say generally that a tap will cut one more thread than the number of its cutters.

A tap with a single cutter becomes a chaser, and will cut equally well—saying nothing about clearance in any of these cases—any multiple of its pitch. It is curious, but I venture to assert that it will be difficult to convince the average thinking mechanic that a single thread tap with two equidistant cutters will not cut a double thread. It cannot possibly do so. Next to a

single thread it would cut a triple thread. In fact, it could not be made to cut any even number of threads; next to 3 threads it would cut 5. J. P. L.'s tap with 8 cutters would, after the 9 threads, next cut 17.

FRANK H. RICHARDS.

Hobbing Worm Gears.

Editor American Machinist:

We have seen two articles in your paper from correspondents regarding "Hobbing" the teeth of worm gears without first rough-cutting them.

Your correspondent in the last issue is correct in saying that the idea and practice is not new, but is wrong in giving the impression that Morse, Williams & Co., of Philadelphia, own bottom patents. They own patents for a particular construction of machine, as do we. See No. 301,270, July 1, 1884. The first drawings were made Nov. 13, 1882. The gear cutter is a combined spur and worm gear cutter. Morse, Williams & Co. have two of these machines, preferring them to the Albro machine. The Yale & Towne M'f'g Co., Bethlehem Iron Co., Otis Bros. & Co,, and many others are also using them. We are now filling an order for the Thomson-Houston Electric Co. We think we were the first and only party that furnished this description of a gear cutting engine. See pages 99 to 102 of our catalogue.

THE PRATT & WHITNEY CO.

Hartford, Conn.

Softening Cast-Iron.

Editor American Machinist:

In the AMERICAN MACHINIST of April 28th your correspondent, "Center Punch," asks for a method of softening cast-iron. Will he try the following:

Heat the cast-iron to a red heat and quench in water about the same heat, and use the same judgment as you would in quenching a piece of steel, then heat again to a red heat, and allow to cool slowly, the same as you would anneal steel.

The above method has given me perfect satisfaction. There may be a difficulty in large pieces, from their liability to crack in quenching, but it will soften them.

THOS. DICKS.

Toronto.

Buffalo International Fair Association.

Regarding this exhibition, which is to be open from September 4 to 14, C. W. Robinson, secretary, has issued the following. We are inclined to believe that the reasons given for a short term are sound:

We wish to call your attention to the advantages which the Buffalo International Fair holds out for an exhibit of your machinery. As you will see by this letter-head, we are erecting a very fine building, the first story of which will be devoted to machinery. At first you may hesitate to exhibit because our term is but ten days, while the usual time is thirty or more.

The Board of Managers decided to hold open for ten days, for no other reason than because they thought they could draw a larger attendance by holding out a most expensive and attractive programme for a short time, than by spending the same amount for attractions, but drawing them out over a longer period. Certainly it will be much less expensive for manufacturers to maintain their display for ten days than for thirty, and experience has shown that a short, well-worked programme draws more people in the aggregate than the larger ones, as ten days is as long as any one will care to look at an exhibit. We cannot see but that a ten-day is better than a thirty-day for the exhibitors themselves.

In the machinery department we are doing everything in our power to make this a notable exhibit. The managers have secured the services of an expert mechanical engineer, Mr. Charles M. Morse, who will have charge of the department, and the correspondence may be held with him, or with the association direct. Every facility possible for showing machinery in motion will be furnished free by the association.

May we ask you to take the matter into serious consideration, and we will place ourselves at your disposal to furnish you with any information you may desire.

Mr. Morse also writes us:

We are to have, in connection with the Buffalo International Fair, a first-class exhibition of first-class machinery, and we propose to so select the exhibits and conduct the exhibition that the best and most progressive manufacturers who do not patronize us this year will regret their action, and apply early next time. Our facilities and backing are ample, and with kind encouragement from friends we will not disgrace them.

C. M. MORSE,
Supt. Dept. of Machinery.

Practical Drawing.

BY J. G. A. MEYER.

FIFTY-FOURTH PAPER.

PROBLEM 69.

475. *Practical application of Problems* 66, 67 *and* 68.

The full lines in Fig. 356 represent a vertical projection, or front view, of the fork end of a connecting-rod for a marine beam engine with a cylinder 56 inches diameter, and 12 feet stroke. The full lines in Fig. 357 represent the horizontal projection or plan, and Fig. 358 represents the side elevation of the same fork-end. In this problem it is required to find curves of intersection

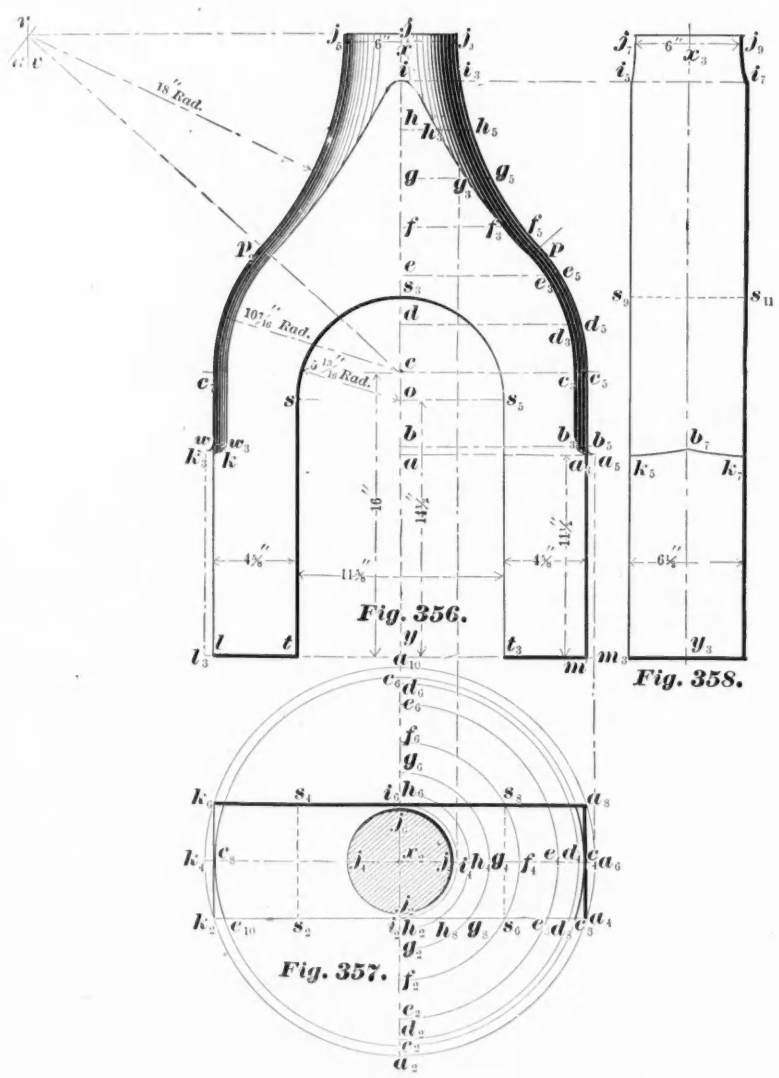

Fig. 356. Fig. 358.

Fig. 357.

$c_3 f_3 i$, in Fig. 356, and $k_5 b_7 k_7$, in Fig. 358.

In the first place we will explain the manner of drawing the outline of this fork-end according to the dimensions given in the illustrations, and thereby recall to memory, and enable us to show the application of some of the previous elementary problems.

Fig. 356. Draw the center line $x\ y$, and perpendicular to the same draw the line $l\ m$. On the center line $x\ y$ lay off a point o; the distance between the point o and the line $l\ m$ must be $14\frac{1}{2}$ inches. From the point o as a center, and with a radius of $5\frac{15}{16}$ inches, draw the semi-circle $s\ s_3\ s_5$ and tangent (see definition, Art. 140), to the same draw the lines $s\ t$, and $s_5\ t_3$, both parallel to the center line $x\ y$, terminating at the points t, t_3 in the line $l\ m$. The line $s_5\ t_3$, drawn tangent to the semi-circle $s\ s_3\ s_5$, can touch the circle in one point only, and this point, that is, the point of tangency, is found by drawing through the center o a line $o\ s_5$ perpendicular to $s_5\ t_3$, the point s_5, in which these two lines intersect, is the point of tangency (see Problem 15), or, we may say, in the case before us, the point s_5 is the junction of the line $s_5\ t_3$ and the semi-circumference $s\ s_3\ s_5$. The same remarks apply to the point of tangency s. Again, 16 inches above the line $l\ m$ lay off on the center line $x\ y$ a point c; from this point as a center, and with a radius of $10\frac{7}{16}$ inches, describe two arcs, $p\ c_5$ and $p_2 c_7$; draw these to such a length as will appear to be long enough—or a little longer than necessary—for the other lines hereafter to be drawn to meet it. Tangent to these arcs draw the lines $c_5\ m$ and $c_7\ l$ parallel to $x\ y$, and terminating at the points l and m in the line $l\ m$. The point of tangency c_5 is found by drawing through the center c a line $c\ c_5$ perpendicular to the line $c_5\ m$, the point c_5, in which these lines intersect, will be the point of tangency. On the line $c_5\ m$ lay off a point a_3 at a distance of $11\frac{1}{4}$ inches above the line $l\ m$; and at the same height lay off a point k on the line $c_7\ l$; the points a_3 and k simply limit the height of the edges $a_3\ m$ and $k\ l$. At any distance which appears to be about right, above the line $l\ m$ lay off two points j_3 and j_5; the distance between each one of these points and the center line $x\ y$ must be equal to 3 inches, making the total distance between these points equal to 6 inches. Through the points j_3 and j_5 draw lines parallel to the center line $x\ y$; the lengths of these lines cannot at present be determined. Our next step will be to describe the arc $j_5\ p_2$, which must be tangent to the straight line drawn through the point j_5, and also tangent to the arc $p_2\ c_7$. Before we can draw this arc we must find the center r, from which the arc $j_5\ p_2$ is to be described. Thus: From the center c, and with a radius equal to the sum of the radii of the arcs $j_5\ p_2$, $p_2\ c_7$, namely, $28\frac{7}{16}$ inches, describe a short arc $r\ u$; at a horizontal distance of 18 inches from the point j_5 draw a straight line $r\ e$ parallel to $x\ y$, cutting the arc $r\ u$ in the point r; from this point as a center, and with a radius of 18 inches, describe an arc $j_5\ p_2$; this arc will be tangent to the line drawn through the point j_5, and also tangent to the arc $p_2\ c_7$. Now, the exact point in which the arc $j_5\ p_2$ will meet the straight line drawn through j_5, that is, the point of tangency, is found by drawing through the center r a straight line perpendicular to the line through j_5; the point j_5 in which these lines intersect, is the point of tangency; the point in which the two arcs $j_5\ p_2$, $p_2\ c_7$ meet each other, that is, the point of tangency of the two arcs, is found by joining the centers r and c by a straight line; the point p_2 in this line will be the point of tangency of the arcs $j_5\ p_2$ and $p_2\ c_7$. Hence we may say that the arc $j_5\ p_2$ extends from the point j_5 to the point p_2, and the arc $p_2\ c_7$ extends from the point p_2 to the point c_7.

Now compare this construction for finding the center r with Problem 23; it will be seen that both are identical. It will be advantageous to the student to refer back to these problems, study the principles involved, and the manner of applying them to working drawings. In following such a course, he will become familiar with the principles underlying practical drawing, enable him in a short time to make working drawings without referring to books or papers, and have confidence in the correctness of his drawings. In a manner precisely similar to the foregoing, the arc $j_3\ p$ is to be described. This will complete the outline of the butt end in the vertical projection.

Fig. 357. For the plan or horizontal projection we prolong the center line $x\ y$ downwards, and on it, at any convenient distance below the line $l\ m$, lay off a point x_2. From this point as a center, and with a radius of 3 inches, describe the circle $j_2 j_4 j_6 j_8$, which represents a section of the rod through the line $j_3\ j_5$, shown in Fig. 356. Through x_2 draw the center line $k_4\ a_6$ parallel to $l\ m$.

Parallel to this center line $k_4\ a_6$ draw two lines $k_6\ a_8$ and $k_2\ a_4$; the distance between each one of these lines and the center line must be $3\frac{1}{4}$ inches, making the total distance between the lines $k_6\ a_8$, $k_2\ a_4$ equal to $6\frac{1}{2}$ inches. Perpendicular to these lines draw the lines $k_2\ k_6$ and $a_4\ a_8$ so that $k_2\ k_6$ and $k\ l$ (Fig. 356) will lie in one vertical line; also $a_4\ a_8$ and $a_3\ m$ (Fig. 356) lie in another vertical line; and lastly draw the dotted lines $s_2\ s_4$ and $s_6\ s_8$ so that the line $s_2\ s_4$ and $s\ t$ (Fig. 356), also $s_6\ s_8$ and $s_5\ t_3$ (Fig. 356) will lie in vertical lines; this completes the plan of the fork end. The lines $s_2\ s_4$ and $s\ t$ represent one and the same surface, but, because in the plan it cannot be seen, the line $s_2\ s_4$ must be dotted; the same remarks apply to the line $s_6\ s_8$.

As to the outline of the side elevation, Fig. 358, we only need to say that the dotted line $s_9\ s_{11}$ represents the height of the opening in the fork-end, and therefore the line $s_9\ s_{11}$ and the point s_8 must lie in one and the same horizontal line. Also, the radii with which the arcs $j_7\ i_5$ and $j_9\ i_7$ are described are equal to 18 inches; and that the centers from which these arcs are described must lie in one and the same horizontal line drawn through the center r. The positions of the other lines the student should be able to determine without further explanation.

To find the curve of intersection $c_3\ f_3\ i$.—From the center x_2 (Fig. 357) draw a circle whose circumference will pass through the points k_2, k_6, a_4, a_8, cutting the center line $k_4\ a_6$ in the points k_4 and a_6; through these points draw vertical lines, thereby obtaining the lines $l_3\ k_3$ and $m_3\ a_5$ in Fig. 356. Make the lengths of the lines $k_3\ l_3$, $a_5\ m$ equal to the lengths of the edges $k\ l$, $a_3\ m$. Then, with a radius of $\frac{1}{2}$ inch, describe an arc which will be tangent to the vertical line $c_7\ w_3$ and passing through the point k_3. In a similar manner draw the arc $b_5\ a_5$. These arcs represent the true form to which the fork end is to be turned. Of course the radius of the arc $b_5\ a_5$ or $w_3\ k_3$ is arbitrary, and can be made more or less, according to the judgment of the designer. Again, from the center x_2 (Fig. 357) describe a circle $c_2\ c_4\ c_6\ c_8$ tangent to the lines $k_2\ k_6$ and $a_4\ a_8$, cutting the line $k_2\ a_4$ in the points c_8 and c_{10}.

We may now assume that (in Fig. 356) the outline $l_3\ k_3\ c_7\ p_2\ j_5\ j_3\ p\ a_5\ m_3$ represents the vertical projection of a surface of revolution, which has been generated by the straight line $l_3\ k_3$, the arc $k_3\ w_3$, the straight line $w_3\ c_7$ and the arcs $c_7\ p_2$, $p_2 j_5$ revolving around the axis $x\ y$. The horizontal projection of this same surface is represented by the circumferences $a_2\ a_6\ a_{10}\ k_4$, $c_2\ c_4\ c_6\ c_8$, and $j_2\ j_4\ j_6\ j_8$. Furthermore, we may now assume that the lines $k_2\ a_4$, $k_6\ a_8$, $k_2\ k_6$ and $a_4\ a_8$ are the horizontal projection of cutting planes passed through this surface of revolution. We have thus reduced our problem to one similar to that shown in Figs. 350, 351, and now have simply to find the intersection

$b_3\ c_3\ f_3\ i$ (Fig. 356) of the cutting planes $k_2\ a_4$ and the surface of revolution; also the intersection $k_5\ b_7\ k_7$ (Fig. 358) of the plane $k_2\ k_6$ and the surface of revolution. The manner of finding the intersection $b_3\ c_3\ f_3\ i$ has been explained in Problem 68, and may be briefly stated thus: Our first step will be to find the highest point i in the curve of intersection. From the center x_2 (Fig. 357) describe an arc $i_2\ i_4\ i_6$ tangent to the lines $k_2\ a_4$, $k_6\ a_8$, and cutting the center line $k_4\ a_6$ in the point i_4; through this point draw a vertical line cutting the arc $j_3\ p$ (Fig. 356) in the point i_3. Through the point i_3 draw a line $i\ i_3$ perpendicular to $x\ y$, cutting the line $x\ y$ in the point i; this point will be the highest point in the curve of intersection. The lowest point of this curve of intersection, $c_3 f_3\ i$, must evidently lie in the line $c\ c_5$, because this line represents the junction of the cylindrical surface generated by the line $c_5\ b_5$ and the double curved surface generated by the arcs $i_3\ p\ c_5$. Therefore divide the distance from the point c to the point i into any number of parts, say six, and through the points of division d, e, f, g, h draw lines perpendicular to $x\ y$, cutting the arcs $i_3\ p\ c_5$ in the points d_5, e_5, f_5, g_5, h_5. Now, with a radius equal to $h\ h_5$, describe from the center x_2, in Fig. 357, a circle $h_2\ h_4\ h_6$, cutting the line $k_2\ a_4$ in the point h_8. Then, in succession, with radii equal to $g\ g_5, f\ f_5, e\ e_5, d\ d_5$, describe, from the center x_2 (Fig. 357), the circles $g_2\ g_4\ g_6, f_2\ f_4\ f_6, e_2\ e_4\ e_6, d_2\ d_4\ d_6$, cutting the line $k_2\ a_4$ in the points g_8, s_6, e_8, d_8 respectively. From the point h (Fig. 356) as a center, and with a radius equal to $i_2\ h_8$ (Fig. 357) describe a short arc cutting the line $h\ h_5$ in the point h_3; this point will be a point in the curve of intersection. In a similar manner make $g\ g_3$ equal to $i\ g_8$, $f\ f_3$ equal to $i_2\ s_6$, $e\ e_3 = i_2\ e_8$, $d\ d_3 = i_2\ d_8$, and $c\ c_3 = i_2\ c_8$. Through the points $i, h_3, g_3, f_3, e_3, d_3, c_3$ draw a curved line, which will be the curve of intersection. More of this in our next paper.

Seymour's New Lathe and Planer Tool.

We have progressed to that degree in machine shop matters, that uniformity and system are considered important factors in economy. In the turning and planing of metals, tool-holders are taking the place of forged tools, as uniformity in cutting angles, temper and quality of steel, is more easily secured in this way.

In shops where a tool dresser is employed, the forged tools which he makes will do the work required in a satisfactory manner, viz.: a clean cut with minimum power, but can be ground only a few times before they must be re-forged. This is expensive, and by repeated heating the chances of burning are great, thus injuring the steel, and impairing its cutting qualities.

Forged tools are an expensive luxury in a small shop, where every man forges his own tools, as these men are not generally skillful tool dressers, and they waste much time and steel in consequence.

One of the especial points claimed for this tool-holder is, that it holds ordinary square or round bars of steel, which require no finishing or fitting, and that it therefore requires the minimum expense in keeping up the cutters. A cutter is made by simply breaking, or cutting off the length required, and grinding the end to the desired angle, and as heavy and clean cut can be taken as with a solid tool of the same size.

The cuts on this page show the construction and appearance of the tool and methods of using it, so plainly as to make further description unnecessary. It will be noticed that there are two V-slots crossing each other, an arrangement which enables the tool to be used either side up, and consequently with the cutter to the right or left as may be desired, as shown in Figs. 3, 4 and 5.

The height of the cutter in the holder can also be easily changed, and it thus answers the purpose of an elevating tool rest. Fig. 2 shows all the parts, together with a round and a square cutter *E* and *F*.

These tools are made by the Capitol Tool Company, Hartford, Conn.

There is no doubt that electric railways are growing in popularity. The advocates of other systems must look to their laurels.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

By W. H. HOFFMAN.

ELEVENTH PAPER.

In the tenth paper we completed the description of the piston-rods, and gave a few leading dimensions of the pistons; they being next in order.

There are many designs for marine engine pistons, and probably two-thirds of them have been discarded for some cause that developed in actual use. The general fault is weakness.

Since it was discovered that the theory of heavy pistons, and other reciprocating parts acting as fly-wheels, cannot be carried out in practice without danger of fracture to these parts, some builders have made their pistons so light that they are easily broken whenever excessive priming sends water to the cylinders.

In the depth of our pistons at the center ($13\frac{1}{2}''$) we have the elements of strength, so much needed at this point, besides the great rigidity of fit, and holding power on the piston-rod.

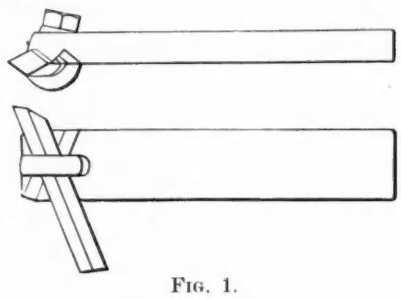

FIG. 1.

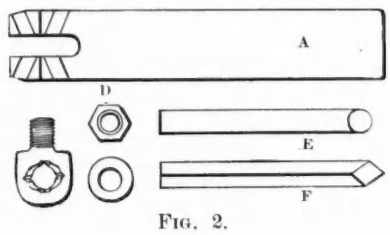

FIG. 2.

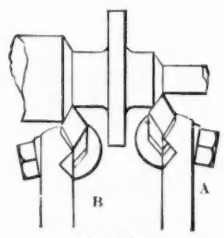

FIG. 3.

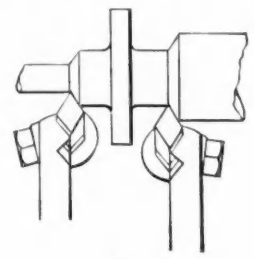

FIG. 4.

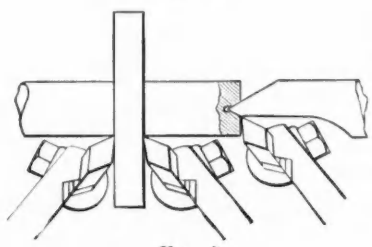

FIG. 5.

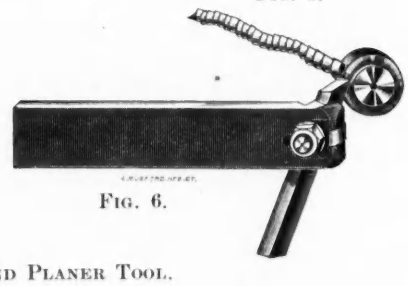

FIG. 6.

LATHE AND PLANER TOOL.

Our pistons will be flat on the upper side, and curved on the lower side, from edge depth of $8\frac{3}{4}''$ to the center depth of $13\frac{1}{2}''$, the lower cylinder heads being curved to suit the form of piston. As we have already described our method of fastening the rods to the pistons, we will now take up the remaining portion of the pistons, the piston-head, springs and followers. The pattern of the piston-head must be made so as to dispense with all large body cores, and thus allow us to cast the head in green sand. By this method the pattern will make its own core spaces for the body, and we can be assured of a casting of uniform thickness; this result being almost impossible with the hollow form of piston-head.

Then, again, there can be no danger of shrinkage cracks, caused by drawing the metal against the large solid cores when cooling.

Large bodies of metal at the hub of the piston must always be avoided, and therefore we make it a rule to make the thickness around the taper sleeve equal to $\frac{1}{8}$ the largest diameter of the taper hole in the piston-head, and, to make even figures, the thickness all around of our piston-head hub will be 3". Connecting with this hub will be eight radial ribs in the high pressure piston, each $\frac{3}{4}''$ thick, twelve in the intermediate piston, each $\frac{7}{8}''$ thick, and sixteen in the low pressure piston, each $1\frac{1}{8}''$ thick; these figures represent the thickness of the ribs where they join the bottom plate web of the piston-head, as there is $\frac{1}{8}$ of an inch draft on the pattern.

The outer ends of the radial ribs connect with an outer backing curb for centering the junk ring, against which rest the springs. The curb is turned for a vertical distance of $1\frac{1}{4}''$, but the upper portion of it is rough. A projecting portion of the follower is turned for a vertical distance of $\frac{3}{4}''$, and the junk ring is centered on these two fitting bands, or strips. Between the junk ring and the outside face or edge of the piston, there will be a distance of $4\frac{1}{4}''$ on the high pressure piston, $4\frac{3}{4}''$ on the intermediate piston, and $5\frac{1}{4}''$ on the low pressure piston; the variation being in the several different thicknesses of the rings.

The thickness of the two outside rings on the high pressure piston will be $\frac{9}{16}''$, on the intermediate $\frac{3}{4}''$, and on the low pressure piston $1\frac{1}{16}''$. Each of the two outside rings will be $3\frac{1}{8}''$ wide, making a total width of packing ring of $6\frac{1}{4}''$ for *all* pistons.

The inside ring on the high pressure piston will be $1\frac{5}{8}''$ thick, on the intermediate $1\frac{1}{2}\frac{3}{9}''$ thick, and on the low pressure piston $1\frac{3}{8}''$. All of these rings will be $6\frac{1}{4}''$ wide, and will be cut through, to allow them to spread against the outside rings. The junk ring will be $2\frac{3}{8}''$ thick, and $6\frac{1}{4}''$ wide for all three pistons, and into its outer face will be cast curved pockets for the springs $1\frac{3}{8}''$ deep at the crown of the curve, and $3\frac{9}{16}''$ wide; the springs being $3\frac{1}{2}''$ wide $\times\ \frac{3}{16}''$ thick.

In explanation of this arrangement I will say that under no circumstances do I believe in fitting a vertical marine piston, with a form of spring that requires adjustment with set screws.

The springs must be carefully designed for the work they have to do, and then they need not be molested until the loss of temper, caused by the heat of the cylinder, and the natural wear of the cylinder bore, and piston rings, call for a new setting to form, and new tempering of the springs.

We do not consider it necessary to describe the many forms of piston springs, and therefore will say that our aim is to make an effective and durable spring; not effective enough (as is frequently the case) to use up seven per cent. of our power in piston-ring friction, but effective enough to be practically tight, and as near frictionless as possible.

To meet the desired conditions we shall make our piston springs of good steel, and of a uniform thickness and width. They will be $\frac{3}{16}''$ thick $\times\ 3\frac{1}{2}''$ wide, and about $6\frac{3}{4}''$ long, or so as to divide evenly on the circumference of the spring space between the junk and inner rings. In form they will be of the coach pattern, with the back portion that rests in the junk ring bent to a curve, the radius of which will be $5\frac{1}{2}''$, while the ends will be turned inward to a radius of 1".

These springs are very effective as to elasticity, and more substantial than those with the ends turned on a reverse curve. They are simple and can be made in a few moments, as there is no forging; simply bending and tempering from the ordinary merchant spring steel $3\frac{1}{2}''$ wide, and $\frac{3}{16}''$ thick.

The depth of the springs, from the front face, bearing against the inside ring, to the back face, resting in the cavity of the junk ring, will be $2\frac{3}{4}''$, thus forming nearly a semi-ellipse, and accounting for its great length. A short bow spring will not live any longer than a short spiral spring, and accuracy and durability can only be obtained by giving sufficient length to the spring to keep within the limits of the fatigue of the metal.

The springs will be alike in all the pistons, and therefore there will be a cast-iron former kept in the engine room stores, which will be used in bending every spring to the uniform curve and length when new, and two similar forms, each a little deeper than the one previously used, to make allowance for the wear of the rings and cylinder bore.

The provision for the removal of a steam piston from the cylinder and rod is an important item in design, and the device for making fast to the piston should be located so that neither the cylinder, its flanges or its tail rod extension will be injured in hoisting.

The tail rod extension of all of the piston-rods will be 4" in diameter, and 6' long; so it will be seen that careless handling of the pistons and cylinder heads is quite sure to damage these extension pieces.

There should be four holes tapped in the piston-head for eye bolts or studs. These eye studs should clamp to the piston-head, a four-armed wrought spider, the hub of which should freely fit the tail rod extension.

When the steam is applied by the overhead traverser, the piston is kept central with the tail rods, and is by them kept from swaying, and at the same time is held square with the bore of the cylinder.

The Deadly Elevator.

We have frequently spoken of the loss of life resulting from the misconstruction and misuse of elevators, setting forth the belief that they were more destructive than poorly constructed and ignorantly attended steam boilers. But the boiler makes more noise in its work of destruction, and it destroys more property in its failure than the elevator. The following, from the New York *Tribune*, is interesting in indicating to what extent the elevator gets in its work:

Few people hear of the shocking accidents which are caused by the falling of elevators in the hotels, places of business, factories and public buildings. In one hospital alone in this city, within the short period of one month, there are recorded nine or ten serious accidents from this cause. The falling of the elevators has resulted in many cases in death; in other cases in fractured skulls and spines and fractured feet and concussion of the brain. Law should direct a most severe punishment against builders of elevators for the defects which make these accidents possible. The innocent public is lulled into the belief that the elevator is safe, because a notice in it states that it is regularly inspected. No punishment is too severe to be inflicted upon contractors who construct these death traps for the public. With greater vigilance on the part of steamship and railroad officials and elevator builders, the present risks to human life can be very much lessened.

The statement of fact in the above is to the point. Regarding the work of inspection, it is as plain as need be that it is defective. There can be such an inspection of elevators as will render accidents from their falling rare indeed. And such inspection should be provided for and insisted upon. Until this is done the elevator will keep along doing a steadily increasing business in filling the hospitals. With the growth of our large cities, elevators are coming more into use, and the danger from their use is being multiplied, not only by the increase in numbers, but from the fact that more and more are liable o fail from the infirmities of age.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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NEW YORK, JULY 14, 1888.

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The Master Mechanics' Association.

The meeting of the Master Mechanics at Alexandria Bay was well attended, and resulted in the dispatch of a good deal of business, and in the presentation and discussion of a number of important reports and topical questions, sprung, as it were, upon the convention without notice. The reports presented and discussed were such as had been deliberately planned for, and hence related to important matters in locomotive engineering while the questions projected by the members for discussion were such as presented themselves to master mechanics in their everyday work of maintaining and caring for the motive power of railroads. Altogether, the matters considered were entirely practical in their character, and such as the entire railroad world is interested in. In fact, a railroad master mechanic is nothing if not practical, his duties preventing him from dealing in theory that is not thoroughly grounded in the severest practice. And this makes the deliberations of the Master Mechanics' Association valuable, not only to railroad men, but to mechanics generally.

If anyone doubts the industry of the members of the Master Mechanics' Association he has only to attend one of their conventions, and note the amount of work that is crowded into three sessions, to find ample grounds for changing his opinion. In truth, the work has come to be too much to be accomplished in the time devoted to it, notwithstanding the association is noted for long sessions, and strict attention to business.

The association is working along slowly in the adoption of standards; those who think greater speed should be made in this direction can hardly have studied the question closely. There is, we fancy, more to it than any but a close observer is likely to see. Locomotives are worked in different parts of the country under widely different conditions, and it is a serious matter to adopt any single detail that shall fit all these conditions, or shall be a satisfactory compromise. The opinions expressed in the replies to the queries of committees appointed to investigate different subjects, and the discussion of the reports of these committees, show what wide difference there is in the experience of different men, who have, presumably, carefully made investigations. Of course this difference of opinion is generally due to the influence of something extraneous, but this does not make the task of getting at exact facts upon which to build any the less easy of accomplishment. Those who have devoted much time to experiments know how difficult it is to eliminate those things that have a real but not desired connection with the question under consideration. In locomotive operation it is practically impossible to make all the conditions save one, uniform, hence the difficulty of correct observation.

Standards in locomotive construction can only be satisfactorily established as a result of careful and extended observations, made by many men, and under a great variety of conditions which indirectly affect the results. It follows that conclusions must be drawn after mature consideration, or they will be worthless. The Master Mechanics are wise in proceeding with caution in this respect. A step backwards will balance a dozen steps forwards. The association cannot afford to go backward. To do so would, in every instance, seriously impair its usefulness. President Setchel's remarks, in his opening address, to the effect that in no single instance had the association found it necessary to reverse its action, presents a record that any association may well be proud of. When the number of important points that have been discussed, and settled, by the Master Mechanics' Association is considered, the members can well afford to rest under the imputation of going slow. Going slow is exactly what makes their conclusions valuable.

The work of the Master Mechanics' Association is one of education, and there is no short road to that. In the present state of the art in locomotive construction and management, improvement must be indicated by tentative processes, and naturally come slowly.

After an existence of twenty-one years, and after having investigated and re-investigated a great many important subjects, there seems to-day more reason for the existence of the Master Mechanics' Association than ever before. There will always be the best of reasons for its existence, because progress in locomotive construction, maintenance and operation will never cease, and practical men, thoroughly acquainted with all the details, must indicate the path of progress. Everyone interested in mechanical progress will be glad to know that the association is in a prosperous condition, and likely to continue its work indefinitely.

Mine Rents and Mineral Royalties.

Before the Manchester Geological Society, Mr. C. M. Percy recently read a paper upon the above subject, which, to judge from an abstract published in *Iron* (London), was a very able handling of the subject, and not without interest in this country, as showing the drift of opinion in England upon a subject very intimately connected with American industrial development. In England, comparatively few owners of mines or mineral lands carry on mining operations. The greater part of such lands have come into the hands of their present owners by inheritance probably, and in that country a man who is the possessor of such land, obtained in such a way, is a "gentleman," and is not expected to do anything, except enjoy himself with the income derived from the rents and royalties paid by those who carry on mining operations.

These rents have been so increased, and, together with other burdens, have become so heavy, that, according to the "highest authorities during the past twelve years, the coal trade, as a whole, had not returned 2½ per cent. upon the capital invested." It seems from the statements made, that it is the custom there to lease coal mines upon a royalty of a fixed amount per ton of coal mined, and that the operator is bound by the terms of his contract to pay a certain minimum amount, whether he mines the coal or not. The result of this is that "hundreds of thousands, it may be even millions, of pounds" have been paid to mine owners for coal which has not been taken from the mines, simply because there was no market for it. This, of course, made the royalty burden heavier upon that which was mined, so that there is now an actual royalty, in some districts, of 1s. 4d. (32 cents) upon every ton of coal placed upon the market. As showing the increase of royalties, "another Yorkshire authority said that leases granted during the years 1872–3–4–5 are, in many instances, as high as 24 cents per ton; and that thirty or forty years ago the average royalty would not exceed 8 cents." This, notwithstanding the fact that the competition of other nations had greatly reduced prices within that time. In this connection, we suppose, the first thought to suggest itself to the mind of an American as a remedy, would be an import duty to protect the operators from the competition of other countries; but upon second thought, it is plain that that would only enable the owners to raise the rents and royalties to a still higher figure, and that the operators and the miners would not be benefited; while those engaged in manufacturing would be the losers, unless they could manage to shift the burden upon their customers.

"Sir Lowthian Bell showed how mineral royalties oppressed English iron and steel makers, and other great users of minerals, and did not oppress those with whom we [England] had an ever-increasing competition. In Germany the ownership of coal is vested in the State, and also the iron ore. The royalty upon coal is fixed at 2 per cent. on the profits of the undertaking, and on iron ore there is no royalty at all. No objection on the part of the owner of the soil is allowed to prevent the minerals on his property being worked, such prohibition being considered as inconsistent with the interests of the nation. In France, all coal and all iron-stone belongs to the State. The fixed rents are indeed nominal, amounting to one cent per acre, and the royalty is based upon 5 per cent. of the profits. In Belgium, all the coal belongs to the State, and, in addition to a very nominal fixed rent, the royalty is 2½ per cent. on the profits."

Dealing with the comparative effects of mineral royalties in England and other countries, Mr. Percy said: "In England, mineral royalties affect pig iron on an average $1.08 a ton, plates for shipbuilding, $1.38 a ton, and steel rails $1.32 a ton. In France, the mineral royalties are on pig iron 16 cents a ton, on plates for shipbuilding 26 cents a ton, and on steel rails 22 cents a ton. In Germany, the mineral royalties are on pig iron 12 cents a ton, on plates for shipbuilding 24 cents a ton, and on steel rails 17 cents a ton." It is thus seen that England is seriously handicapped in the industrial race with her foreign competitors, without taking difference in wages into account at all, and, in fact, when the difference in productive capacity is considered, there is probably little difference in wages.

Concluding, he said: "Relief must come from the quarter which had experienced nothing of the effects of our unparalleled depression, namely, in an abatement of the conditions of mining leases and the amounts of mineral royalties. He asked the royalty owners of the United Kingdom, in the interests of the nation and of themselves, to be wise, and above all (remembering the progressive and democratic age in which we live) to be wise in time, for there was danger in delay."

There is much food for serious thought in the above. It is a question which is affecting, and will more and more affect, our industrial interests. The fact that mines are usually worked by the owners in this country, and no rents or royalties are paid as such, by no means relieves us from these burdens. The owners of the mines, and the railroad companies which transport their products (in many cases one and the same company) see that all the burdens of that kind are laid upon industrial enterprises which can be borne, and we foolishly help them in their schemes of monopolization by assessing unworked coal lands, bought and held by the coal barons to prevent others from working them, as unimproved farm lands worth $12 an acre—lands which could not be purchased for $5,000 an acre. In addition to this we "protect" them from foreign competition, at the same time that we allow them freely to hire their labor in the cheapest market; in return for all of which, they are building up a system which will some day, and, in fact, to a great extent is now, throttling the real industrial interests of this country—those industries such as our readers and friends are engaged in, and in which brains and energy are employed in perfecting and developing products and methods of manufacture, instead of in devising new schemes of plunder.

A Worthy Appeal.

Mr. Emory Edwards, known to many of our readers as author of several works on steam engines and steam machinery, has for some time been afflicted with a lingering but incurable disease. He has exhausted his means of support, and is dependent upon his friends. If the sum of $100 can be raised, it will secure his admission to an institution where he will receive proper care during the remainder of his life. Mr. Edwards' sickness is not the result of any wrong doing on his part. The small sum of money named will make him as happy as it is possible for him to be made in this world, and we believe there are many of our readers who will be glad to contribute to that end. We will take charge of any contributions forwarded us for that purpose, and see that the money is used for the purpose named. We believe Mr. Edwards to be entirely worthy. Any sum, however small, will be appreciated, and due acknowledgment will be made in each instance by mail.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(321) Reader, Towanda, Pa., asks: Can brass be melted with as good results on a black smith forge as in a regular brass furnace? *A.*—No. We shall endeavor to publish an article on the subject you ask for.

(322) W. F. O., Plainfield, N. J., writes: Please give me a cheap mixture for filling small blow holes in cast-iron. *A.*—Babbitt metal usually answers very well, and some of it is cheap enough for most anything.

(323) C. S. S., Towanda, Pa., writes: Can you give me a point on welding copper to iron? I have had a job brought in, of welding 1 inch round iron to ¼ inch round copper. I want to know how to do it in a country shop equipped with ordinary tools. *A.*—It is said that copper can be welded to iron by an electrical process. The usual way, and probably the one that will suit you the best, is to braze it on.

(324) R. R., Romley, Col., writes: Would you please inform me what percentage I would lose, by using a sheave to change direction of cable on hoisting engine, the sheave to be placed at right angles to and between the sheave proper and the engine, as in sketch: cable ¾ inch diameter; sheave 3 feet diameter; load 1 ton. *A.*—If the sheaves are correctly placed in line, and the journals kept well lubricated, you will lose not less than 10 per cent.; the probabilities are that the loss will run up to 15 per cent.

(325) C. H. M., Utica, N. Y., writes: Can you give me a receipt for making a cement for cementing rubber tires to steel rims, or cement for rubber on iron? *A.*—See answer to Question 6, in our issue of January 7, 1888. 2. What is the process of making ruboer tires? *A.*—Manufacturers are not willing to give all the details of this process, to enable us to give a complete and satisfactory description of the same It seems to us that if you intend to go into the business, the best way would be to engage a man perfectly familiar with the subject.

(326) E. W. B., Toronto, Ont., writes: Please state if there is any variation between Stubbs and American wire gauges? *A.*—Yes, there is a difference. Stubbs' wire gauge is supposed to agree with the Birmingham wire gauge, which differs from the American gauge. But there are two Stubbs' wire gauges differing entirely from each other, one used for iron wire, the other for steel wire. Altogether the wire gauge matter is very much mixed, and we think, now that there are other and better methods of determining the size of wire, that it would be better if all gauges, on which the sizes are designated by numbers, were to be abolished entirely, and wire designated and ordered by its actual diameter in decimal parts of an inch.

(327) F. H. F., Beaufort, S. C., asks: Can you inform me how to electroplate steel articles with copper? I have no trouble in getting a fine coat of copper on the articles, but it rubs off, and what I want is something to make it stick. *A.*—As you seem to be sufficiently acquainted with the electroplating process to secure a deposit of copper, we do not know that we can help you, but you should see that the articles, before going into the bath, are entirely free from dirt, oil or oxide. Perhaps it is failure to attend to this point which causes your trouble. Or perhaps you do not deposit thick enough. Copper is a comparativeiy soft metal, and a very thin coat of it would be easily worn or rubbed off. We are inclined to think that this is the cause of your difficulty.

(328) B. D. W., Great Falls, Mont., writes: I am not a book mechanic, but think a certain class of book matter indispensable to a man who is called on for all classes of work. I would like you to recommend a standard authority on the proportioning of water systems. *A.*—J. Weisbach's Theoretical Mechanics, we believe, is generally recognized as one of the standard works, and will answer your purpose, providing you have a fair knowledge of the higher branches of mathematics; otherwise it will prove to be difficult reading. 2. Which is rocognized as the best in its line, Trautwine's or Haswell's, for general reference? *A.*—Both are excellent in their line; Trautwine's is more suitable for civil engineers; Haswell's is better adapted for the use of steam engineers. For general reference you will need both.

(329) T. H. M., Richmond, Ind., asks: Is it a fact that the finest lathes and other metal-working machinery come from the old country? *A.*—No. On the contrary it is conceded that the finest lathes and other metal-working machines are made in America, and some of them are purchased and sent to the "old countries." Many of the foreign armories are equipped entirely with American machinery and tools for the production of small arms, and the same is true of some sewing machine shops. And in the line of watch making lathes and other watch machinery, America takes the lead, and such machinery, instead of being imported, is exported. A great many Brown & Sharpe universal milling machines have been sold abroad, and the same is true of the Gould & Eberhardt automatic gear cutters, and we suppose other makes of similar machines. The older countries excel us in some kirds of very heavy machinery, but in lighter fine machine tools we unquestionably excel them; a fact which has been repeatedly demonstrated.

(330) C. E. B., Philadelphia, asks: Will you please give me your method of calculating the following arrangement of power, and what the probable percentage of loss from friction would be? Crank 10 inch long on worm shaft, having worm of ½ in. pitch, gearing to worm wheel of 8 inch pitch diameter, or 50 teeth, and then equal geared to a screw (the last gear containing the nut). Screw is ½ inch pitch, and draws a weight in line of its axis. *A.*—The simplest way of computing all such problems is to consider the relative rate of motion of the applied power, and the weight. The force, neglecting friction, will be in inverse proportion. In this case the circumference of the circle moved through by the power = 62.83 inches. The worm wheel having 50 teeth, will be turned 1-50 of a revolution to each turn of the worm. The screw being ½ in. pitch the weight will be moved during each revolution of the worm a distance equal to .5″ ÷ 50 = .01″. In other words, when the power applied to the crank moves 62.83 inches, the weight moves .01 inch, and the force gained by the arrangement, neglecting friction, is in the proportion of .01″ to 62.83″ or 1 to 6,283. As to the amount of friction there would be, this depends upon so many conditions (many of which you have neglected to state), that it is impossible for us to give you a rule for it. It would probably amount in the whole machine to not less than 75 per cent., depending upon the amount of mechanism, the workmanship, the proportions of the various parts, lubrication, etc. The coefficient of friction may be determined by replacing the crank with a pulley 20″ diameter, and hanging weights over the pulley until the machine moved. Do this with the machine unloaded, and loaded with various weights. You will then have data from which to arrive at the coefficient of friction, and we think that is the only reliable way of doing it. You will find some results of experiments upon the friction of worm gears, by Prof. R. H. Thurston, in the AMERICAN MACHINIST, of Nov. 1, 1884.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

See Grant's Gear advt. on back page.

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See our new designed shapers in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed brass working tools in Cincinnati Centennial Exposition Lodge, Davis & Co.

2,000 feet of space in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See special ads. pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee, Falls Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Improved fine tools for mechanics, manf'd by L. S. Starrett, Athol, Mass. Send stamp for full list.

"Swift" Sight-feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Brown & Sharpe Mfg. Co., have a line of machinery with S. A. Smith, 23 S. Canal st., Cnicago, Ill.

Patents—Whittlesey & Wright, 705 8th st., N. W., Washington, D.C. Send for pamphlet and references.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Cnicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers Frasse & Co., 92 Park Row, N. Y.

Most sensitive and durable Damper Regulator made; works within one pound: send for circular. T. Kieley, 11 West 13th st., New York.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st. N.Y.

Patent Att'y. R. G. DuBois, 916 F. st., Washington, D. C. Reliable service at reasonable rates. Send for 38-page pamphlet containing list of references.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See July 7, p 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Upright drills, improved, sizes 21″, 23″, 25″, 28″, 32″, 36″ swing: finely made and great capacity; write for cuts and prices. Currier & Snyder, Worcester, Mass.

Fine tools and supplies for machinists and other metal workers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., New York City.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

A practical treatise on the steam engine, by Arthur Rigg, essays on the principles involved in design and construction of fixed engines; 312 pages, with 96 plates, 4to. cloth, $10.00. E. & F. N. Spon, 12 Cortlandt st., N. Y.

For the manufacture of
Patented articles in line of machine work;
Specialties in fine light machinery;
Accurate cam cutting;
Address Wardwell S. M. Co., Woonsocket, R. I.

James D. Cardell & Co., 1900 Passyunk ave., Phila., Pa. boiler makers and sheet iron workers, m'f'rs of coils of wrought-iron pipe, return bends, etc. Address after June 15, Rising Sun Lane and North Penn R. R. Boiler repairs promptly attended to.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including June 30, 1888 issue, 53 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 68 articles have thus far appeared up to and including the July 7, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York

MANUFACTURES.

The P. Cox Shoe Company are building a new factory at Rochester, N. Y.

F. H. Smith will build a box factory, also a sash and blind factory, at Bangor, Maine.

The part of the Disston Saw Works, Philadelphia, Pa., recently destroyed by fire, is being rebuilt.

The Missouri Malleable Iron Company, St. Louis, Mo., have orders sufficient to keep them busy till September.

Lodge, Davis & Co., Cincinnati, Ohio, will display $20,000 worth of machine tools at the Centennial Exposition at Cincinnati.

The Texas Mill and Elevator Co. of Corsicana, are putting in sufficient machinery to increase their capacity 100 barrels per day, making a total capacity of 300.

Detrick & Harvey, Baltimore, Md., have issued a two-leaf circular, arguing the advantages of their open-side planer. The circular is well worth the consideration of machinists.

In 1884 the Trenton City Bridge Company painted their iron bridge (1275 feet long) across the Delaware river, with graphite paint, and inspection now shows that after 4 years' wear the paint is as good as when it was put on.

W. H. Lambert & Co. will erect a 60 barrel mill and warehouse at Kasota, Minn., the contract having been awarded to the Willford & Northway Mfg. Co. The mill will make rye flour, wheat flour and corn meal. Work will be commenced on it at once.

Wesley Hutchins' box factory at Auburn, Me., recently destroyed by fire, will be rebuilt at once. The building was 50 x 130 feet and five stories high. Mr. Hutchins will continue the business. The new building will be similar to the old one, but will be six stories high.

The Schenectady Locomotive Works, Schenectady, N. Y., have nearly completed their new blacksmith shop, which is 75 x 350 feet. Locomotives are being built at the rate of 300 a year, and most of them are large ones. Four large consolidation are building for the N. Y. Central.

The Newark Leather Belting Company, Newark, N. J., New York office 32-34 Ferry street, New York, send us price list of leather belting. The list is on a large card arranged for hanging. In addition to the list of belting, the card embraces a calendar, table for calculating wages, etc.

The American Bolt Company, Lowell, Mass., are erecting an engine and boiler house, two stories high, which will also contain a cutting up room. The building will be of brick, 77 x 31 feet, and will make a needed addition to their plant. When in operation the new part will add about ten per cent. to their capacity.

The city of Nashville, Tenn., has about concluded arrangements for the sale of $300,000 worth of city water-works bonds. By an act of the legislature, the city is authorized to issue $1,200,000 in bonds for water works purposes, and of this amount $60,000 have already been closed out, three-fourths of the whole amount will be issued.

Dr. Gatling, of Hartford, inventor of the repeating battle-gun that bears his name, will soon begin the manufacture of a new solid steel gun, which will introduce a new phase into heavy ordnance making. The new gun can be made quicker, and at a quarter of the cost of the Krupp gun, to which it is claimed to be superior.—*Springfield Republican.*

It has been settled that there is to be a new gun factory at Northampton, Mass. A company has been organized, with a capital of $50 000. Mr. George E. Forbes, of North Brookfield, is the president, and W. H. Whitney, inventor of the gun which is to be manufactured, is the treasurer. The company is to be known as the Whitney Safety Arms Co.

We have received the catalogue and price-list of The Lufkin Rule Company, Cleveland, Ohio. It is well printed and illustrated on good paper, and gives full information regarding their production, which include steel rules and tapers, steel board rules, hickory board and log rules, boot calks and sets, and other miscellaneous specialties for lumbermen and others.

The Nickerson Piano Company, of New Bedford, Mass., was organized recently at Bath, with a capital stock of $100,000, and the following list of officers: President, Capt. William Lewis; clerk George H. Nichols; assistant clerk, Charles H. Holden; treasurer, Frank R. Hadley; directors, Wendell H. Cobb, H. B. Nickerson, James C. Stafford and William Lewis. The office of the corporation is at Bath, Maine.

The Bessemer Steel Works at Pueblo, Col., have shipped eighteen car loads of steel rails to Washington Territory for the Seattle & Eastern Railroad, which is now being built from Seattle to Spokane Falls, where it will connect with the Manitoba Railroad, which is to be the connecting link of a new transcontinental line. These are, we believe, the first steel rails ever shipped to the Pacific coast from a manufactory west of the Missouri river. Eighteen additional car loads will follow these.

Work on the new plant of the Westinghouse Air Brake Company, to be located at Turtle Creek, eleven miles from Pittsburgh, Pa., will soon be commenced. When the plant is completed it will have a capacity of 500 complete equipments per day. The works of the company in Allegheny City have a capacity of 150 equipments per day. They will be operated in connection with the Turtle Creek plant, which will furnish a total capacity of 650 equipments per day. Both passenger and freight brakes will be manufactured.

The Aerated Fuel Company, Springfield, Mass., write us: Our process is now working with the utmost satisfaction in Ohio and other places, and at the Ashtabula Tool Company Works they are fully equipped, and to the entire exclusion of coal. At the above named company's works we are making 5 gallons of oil per day do the work of 200 pounds of coal the oil costing 7 cents for 10 hours, and coal for the same time costing 50 cents. In addition to the cost of coal should be added the time it takes a man to wheel in the coal, remove the ashes, which costs 4 cents per fire, leaving a net cost for oil as 3 is to 50. Other companies are sending us records similar to this.

The Hargraves Mill Corporation recently organized in Fall River, Mass., with the following officers: Treasurer, Seth A. Borden; Clerk, Milton Reed; Directors, Reuben Hargraves, Thomas Hargraves, S. A. Jencks, Geo. A. Draper, R. P. Snelling, James E Cunneen, Leander Freelove, Milton Reed, A. J. Chace, Albert Nichols, Geo. G. Silsbury, John Barlow, Seth A. Borden. The capital is $400,000. It was voted that the directors be authorized to proceed to erect a cotton mill and acquire real estate and make the necessary contracts for the purpose. The first assessment on subscriptions to the stock is payable July 1, and the assessments follow from that time monthly until March 1, 1889. The mill which the corporation will build will have about 35,000 spindles, and the work of construction will commence immediately.

The development of the water power at Otis Falls, Livermore [Me.] by the construction of the new pulp mill, has given great impetus to the growth of the village. The dam was built several years ago, but the Otis Falls Pulp Company initiated the first movement to prevent the water from running to waste last October. Their mill, which is now nearly completed, is 283 x 75, and a fine specimen of solid work, with granite and brick walls. R. D. Shannahan, the contractor, in excavating for the foundation, removed between 10,000 and 12,000 yards of earth, and put 4,000 yards of stone into the ground work or foundation. Twenty-two water wheels have been put in. They have now six wet machines nearly set up, and are putting in the grinders; also a cutting-off saw. About thirty cords of wood will be consumed daily by the grinding process, making about twenty tons of pulp. A paper mill will probably be erected there by this company in the near future.—*Industrial Journal.*

Machinists' Supplies and Iron.

NEW YORK, June 28, 1888.

Iron—American Pig—We quote Standard Lehigh brands $18 to $18.50 for No. 1 X Foundry; $17 to $17.50 for No. 2, and $15.75 to $16.25 for Grey Forge, with outside brands cheaper, but still difficult to quote.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p 11.

Mech. draftsman, graduate from tech school, with 3 years exp. wishes situation. Box 107, AM. MACHINIST.

Wanted—Competent machinists on lathes and planers. The Pond Machine Tool Co., Grant ave., Plainfield, N. J.

Wanted—A practical designer and draftsman, to make new drawings for automatic and plain slide valve engines. Address Shop, AM. MACHINIST.

A first-class mechanical draftsman and electrical engineer, graduate from technical school, is open for engagement. Address G. S., AM. MACHINIST.

Wanted—Situation as foreman or salesman by machinist experienced on experimental and general mach'ry; references. C. B., AM. MACHINIST.

Wanted—Position as general foreman; thoroughly posted on all kinds of engines and general machinery; first-class references. G. M., AM. MACHINIST.

A young man, at present in charge of the drawing room of a large establishment manfg. Corliss Engines and general machinery, desires to make change. Box 106, AM. MACHINIST.

Wanted immediately, five experienced first-class brass finishers to work in our new factory at Dunkirk, N. Y.; no one but first-class workmen need apply. Martin Anti-Fire Car Heater Co.

Wanted—A smart, ingenious mechanic, who understands working small tools, drills, millers, etc.; salary $2.50 per day; young man preferred. Address "A," Letter Carrier 31, Buffalo, N. Y.

A man with 14 years' experience on general machinery, is a designer and can handle men, indoors or out, wishes an engagement where push will be rewarded. Address No. 33, AM. MACHINIST.

Wanted—A first-class draftsman, experienced in machine tools for machine shop and railroad use; none but competent, first-class men need apply; state experience, age, and wages required, to Box 101, AM. MACHINIST.

Wanted—Position by experienced designer and draftsman, with extensive and varied practice in steam engine, locomotive and mining work. Colorado or other Western State preferred. Address John Ives, Box S, Trinidad, Col.

Wanted—A practical foundry foreman, by a car manufacturing company; to satisfactory man fair wages and steady employment will be assured. Address, giving references and stating experience and salary desired, M. D., AM. MACHINIST.

Wanted—A practical machinist to work on stationary engines, and go out to set up engines and boilers for electric light companies; must have some ability as a salesman; middle aged, unmarried man preferred; must be strictly temperate; a permanent salaried position to the right man; must come well recommended. Engine Co., AM. MACHINIST.

Wanted—Foreman for boiler works, who has had experience in all kinds of work; must be able to read drawings, make estimates, lay out his own work, and work men and tools to their full capacity; steady employment and good salary paid to the right man. Address with references, stating age and experience; none but sober and industrious mechanics need apply. Energetic, AM. MACHINIST.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, Ohio.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland, O.

D. J. Kelsey, M. E., 31 Ins. Bld., New Haven, Ct. Machine designing, also Patent Office drawings.

Wanted—Parties having machinery specialties to build, to correspond with. Box 75, AM. MACHINIST.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

Wanted—Parties having specialties to manufacture, correspond with Cedar Point Foundry and Machine Shop, Port Henry, Essex Co., N. Y.

Wanted—M'f'rs and dealers in mach'ry and all articles used in engineering to send their catalogues, etc., to Mechanical Engineer, care AM. MACHINIST.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert streets, Cincinnati, Ohio.

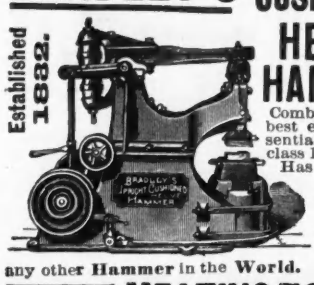
August C. Christensen, M. Am. S. M. E., 24 State st. (Battery), N. Y.; 463 Henry st., Brooklyn. Working drawings and superintending the building of machinery; steam, pumping and gas engines indicated.

"We wish to communicate with the manufacturers of the toughest No. 12 and 14 steel wire obtainable, also of light steel tubing 1 inch and 1¼ inch outside diameter." Gormully & Jeffery Mfg. Co., Chicago, Ill.

Ernest W. Naylor, consulting and mech. engineer. Plans and estimates for steel work and forge plant. Hydraulic presses, cranes, etc; 20 years' exp. with the best English firms. Offices J. & K., 149 B'way, N.Y.

For Sale—Machine shop, foundry and forges, to settle an estate; business established 40 years and never shut down for want of business; running at present 16 men entirely on job work, which can be doubled in one year by practical party; price reasonable and terms easy. Address F. R. Page, Olean, N. Y.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



Established 1882.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

Bradley's HEATING FORGES

Established 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

Pat. Aug. 30, 1887

For hard coal or coke. Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

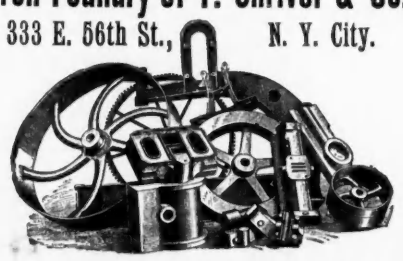
BRADLEY & CO., Syracuse, N.Y.

STEPHENS PATENT VISES.

ONE HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular.

TOWER & LYON,
95 Chambers Street, New York.
Successors to MELVIN STEPHENS.

Iron Foundry of T. Shriver & Co.,
333 E. 56th St., N. Y. City.



Nice Castings, Smooth and True to Patterns, of very best brands of Pig Iron.
CASTINGS IN QUANTITY AT FAVORABLE PRICES.

"Star" Foot Lathe Swings 9x25 in.

LATHE

Screw Cutting Automatic Cross Feed, etc.

Scroll Saws, Circular Saws, Lathes Mortisers.

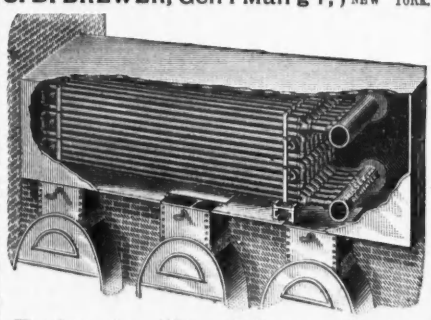
LATHE

Catalogue Free of all our Machinery.

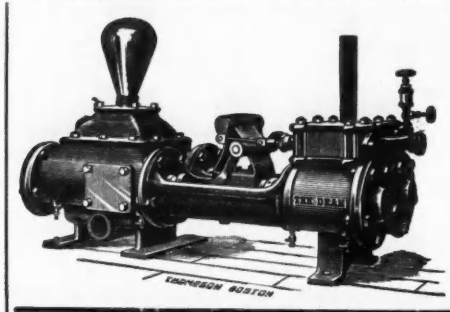
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y

THE HUSSEY RE-HEATER and STEAM PLANT IMPROVEMENT CO.

A. S. HATCH, President,
S. D. BREWER, Gen'l Man'g'r, } 15 Cortlandt Street, NEW YORK.



Engineering, Steamfitting, and Designing, Remodeling and Improving Steam Plants. Consulting experts in all matters pertaining to the use of Steam and Heat.



THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia, St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

SECOND-HAND LATHES FOR SALE.

14 in. x 6 ft., Blaisdel.	14 in. x 6 ft., Star Tool Co.
16 " x 6 " Ames Manufacturing Co.	16 " x 10 " Bridgeport.
18 " x 8 " Star Tool Co.	22 " x 8 " Star Tool Co.

1 Davis Key Seater, *new*, with full set Cutters, ⅛ to 1 in.

THE HENDEY MACHINE CO.,
TORRINGTON, CONN.

BEST CAST STEEL.

For MACHINISTS' TOOLS and DIES DOING CONTINUOUS HARD WORK.
MILLER, METCALF & PARKIN, CRESCENT STEEL WORKS,
CHICAGO, ILLS. PITTSBURGH, PA. NEW YORK, N. Y.

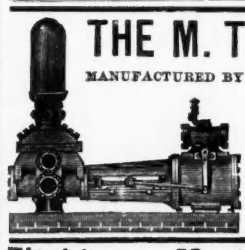
Sebastian, May & Co.'s Improved Screw Cutting
FOOT AND **LATHES** POWER

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
167 West Second Street, CINCINNATI, O.

OUR NEW 18 In. POWER ENGINE LATHE IS NOW READY

GUILD & GARRISON, Kent Ave. and South 10th St., Brooklyn, N.Y.
Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, etc.

THE M. T. DAVIDSON IMPROVED STEAM PUMP



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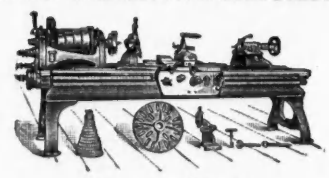
DAVIDSON STEAM PUMP COMPANY.
WARRANTED THE **BEST PUMP** MADE FOR ALL SITUATIONS.
PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.
NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

Fitchburg Machine Works.
Manufacturers of
METAL-WORKING MACHINES.



OFFICE AND WORKS,
13 to 21 MAIN STREET,
Fitchburg, Mass.
Send for Catalogue (E.)

BUSINESS OPPORTUNITY.

Heating and Ventilating of Houses, Schools, &c., by Steam.

NEW PROCESS.

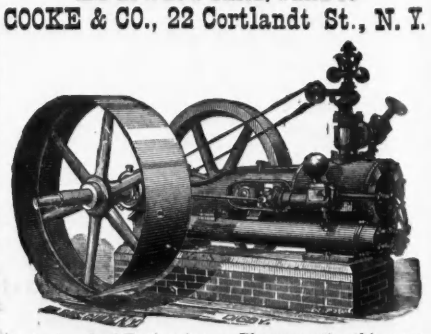
Having perfected my system, covered it by American patents, given it a three years' test and proved its efficiency to successfully compete advantageously with any system in the market, and having designed and corrected a full set of four sizes of patterns, with illustrated catalogue under print, I am prepared to negotiate with principals of responsible firms or companies for the sale of American interest and control of said patents when the same have been fully granted. System has been partly illustrated in this paper. Further particulars on application. Apply

R. W. KING & CO.,
GEORGETOWN, ONT.

TANITE FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS
EMERY WHEELS and GRINDING MACHINES
For Circulars address
THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.
Or H. A. ROGERS, 19 John St., N. Y.

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND
J. WYKE & CO., **TWIST DRILL GAUGE.**
Fine Machinists' Tools.—E. Boston, Mass—Send for Circular.

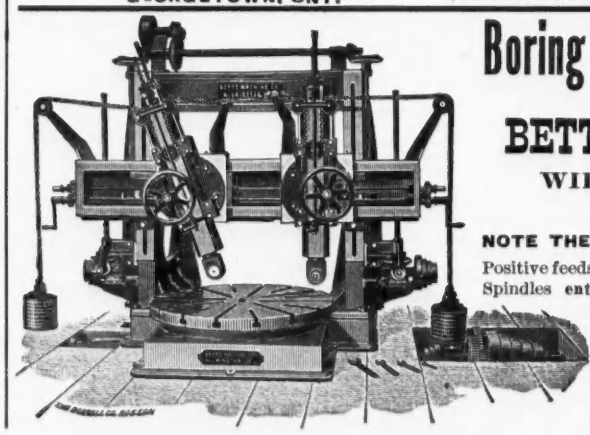
IF YOU WANT A STRONG, ECONOMICAL
ENGINE
EITHER HORIZONTAL OR VERTICAL,
FOR STEADY EVERY DAY AND ALL-NIGHT SERVICE AND AT A LOW PRICE, *WRITE TO*
COOKE & CO., 22 Cortlandt St., N. Y.



Twelve hundred Engines in use. Please mention this paper

GEO. F. BLAKE MANF'G CO
BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., 111 FEDERAL ST.,
NEW YORK. BOSTON.
WATER WORKS PUMPING **ENGINES A SPECIALTY**



Boring and Turning Mills
MADE BY
BETTS MACHINE CO.
WILMINGTON, DEL.

NOTE THE FOLLOWING ADVANTAGES.

Positive feeds, no friction.

Spindles entirely independent, can be moved simultaneously in opposite directions with different grades of feed.

Spindles not round, but of such shape as will allow ready adjustment for wear.

Great range of feed and abundance of power.

Send for list of machine tools on hand for immediate delivery.

NICHOLSON FILE COMPANY,

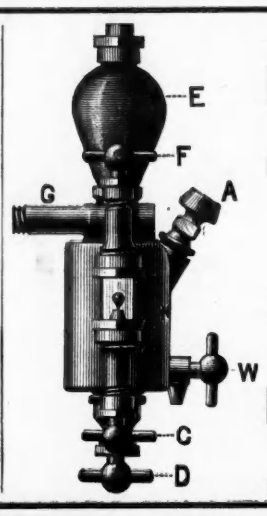
PROVIDENCE, R. I.

Files and Rasps,

OF EVERY VARIETY, INCLUDING THEIR

TRADE
EXTRA X.F. FINE.
MARK.

FOR FINE TOOL MAKERS, JEWELERS, SILVERSMITHS, WATCHMAKERS, ETC.



THE "VOLUNTEER"
UP-DROP, SIGHT FEED, LUBRICATOR,

(GATES PATENT.)

FOR STATIONARY ENGINES AND PUMPS OF ALL KINDS. LUBRICATORS FOR SINGLE OR DOUBLE CONNECTION.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	⅓ pt.	½ pt.	¾ pt.

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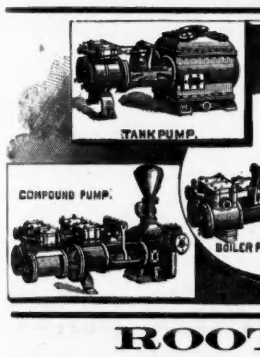

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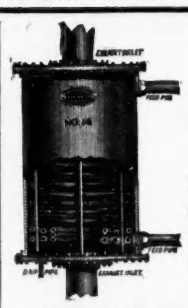

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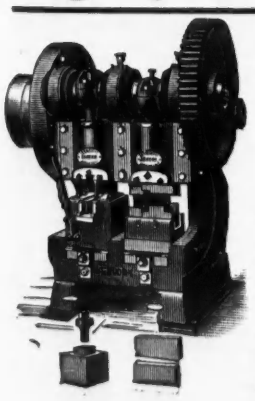

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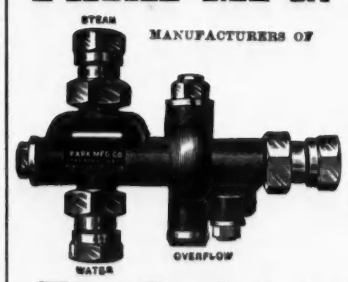

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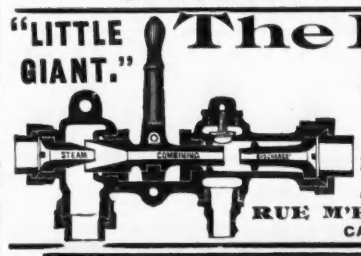

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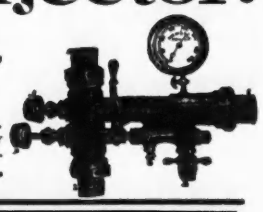

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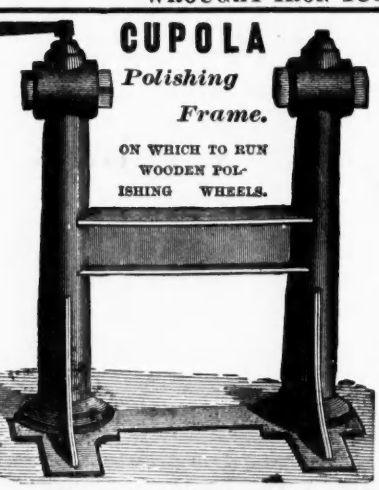

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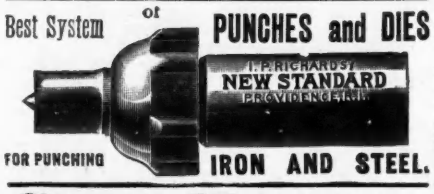

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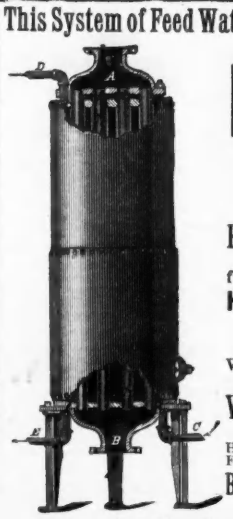

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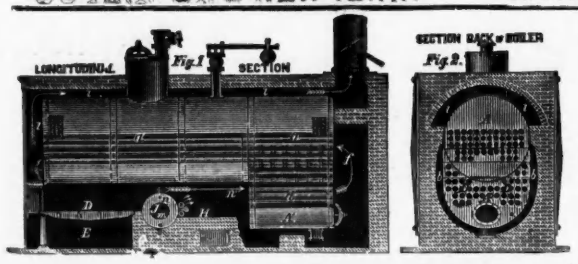

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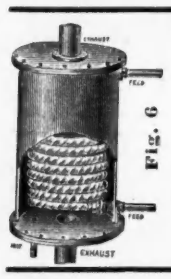

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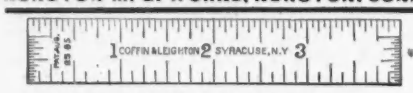

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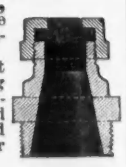

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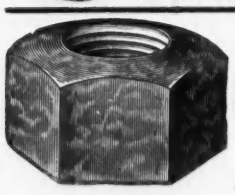

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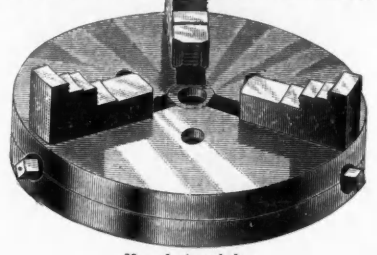

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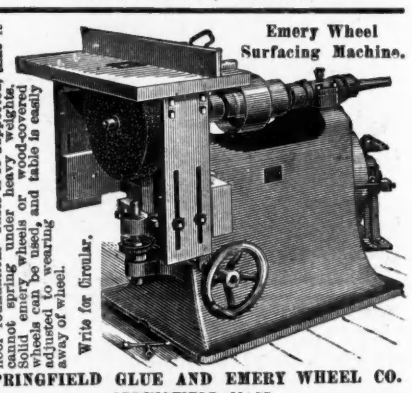

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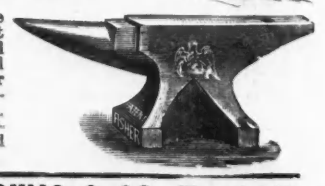

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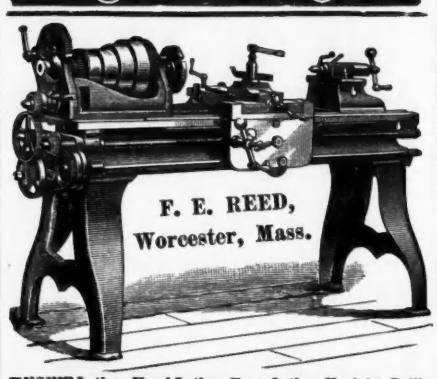

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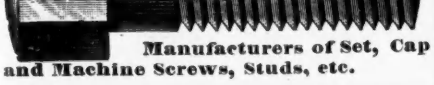

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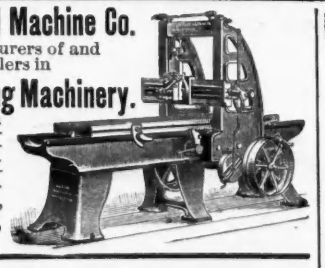

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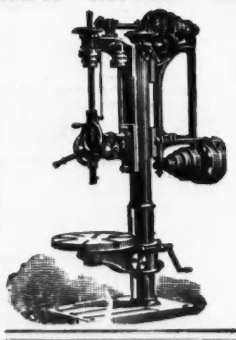

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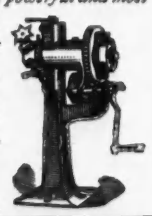

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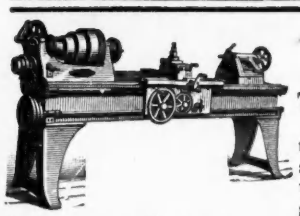

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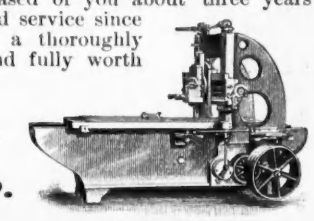

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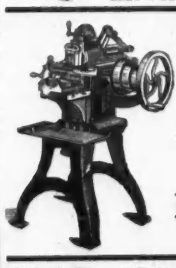

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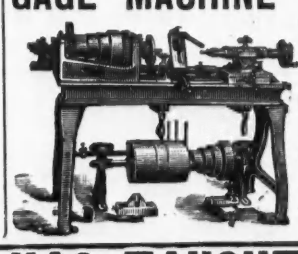

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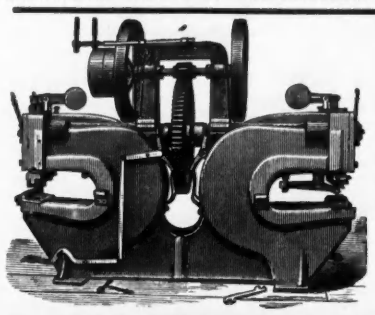

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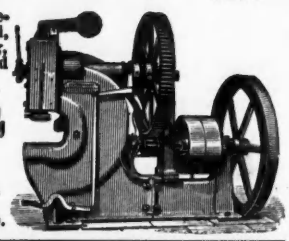

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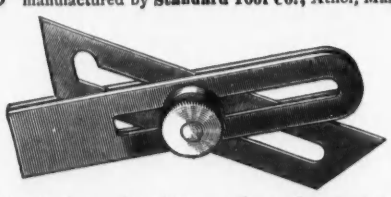

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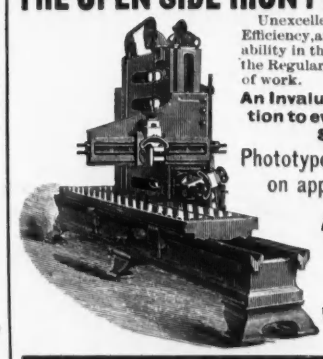

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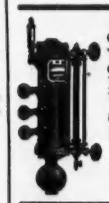

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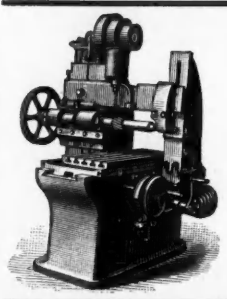

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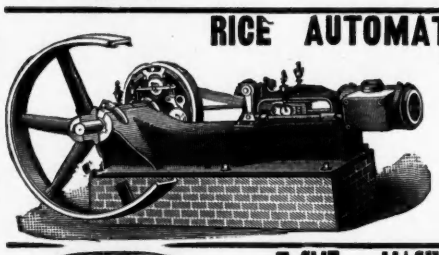

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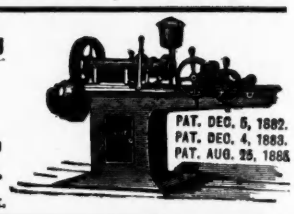

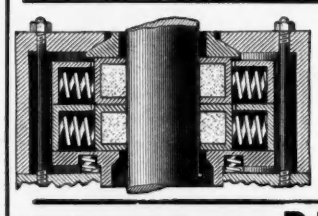

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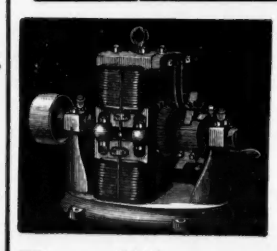

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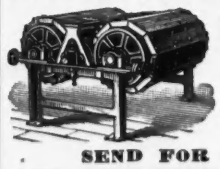

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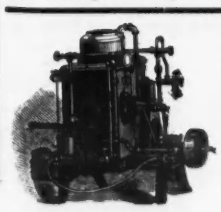

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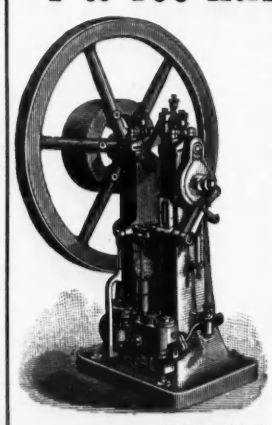

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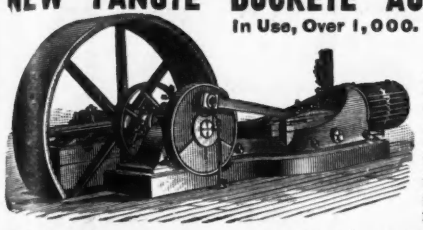

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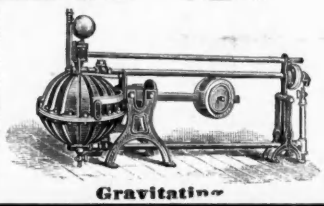

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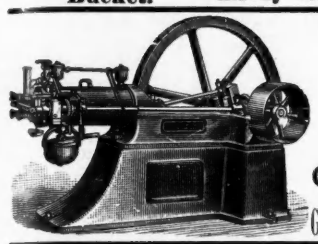

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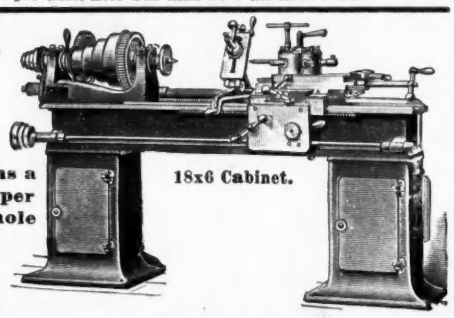
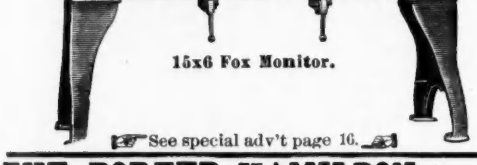


18x6 Cabinet.



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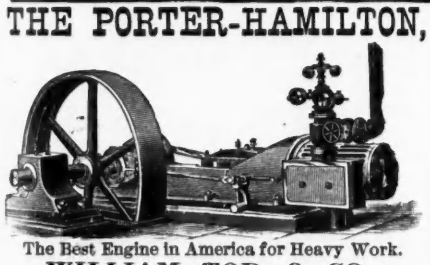

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16 in. x 6 ft.	"	Ames,	A 1.
16 in. x 6 and 8 ft.	"	Blaisdell	new.
16-20 in. x 6-8-10 & 12 ft.		Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
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20 in. any length Bed	"	Bridgeport,	"
22 in. x 12 ft.	"	Niles,	heavy.
23 in. x 8-10 12 & 14 1 2	"	Bridgeport,	new.
26 in. x 12 ft.	"	Wright,	new.
28 in. x 16 ft.	"	Fifield,	"
36 in. x 14 ft.	"	Fifield,	"
2 in. Drill		Davis.	"
20-25-25-28 inch Drills		Blaisdell,	"
20-25-28 32 inch	"	G. & S.	"
5 ft. Arm Universal Radial Drill,			"
No. 1 and 3 Universal Miller, Brown & Sharpe,			"
No. 1-2 and 6 Plain	" " "		"
No. 1 Universal Grinder,	" "		"

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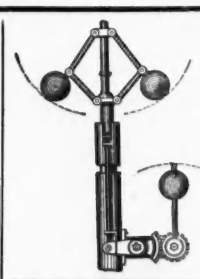

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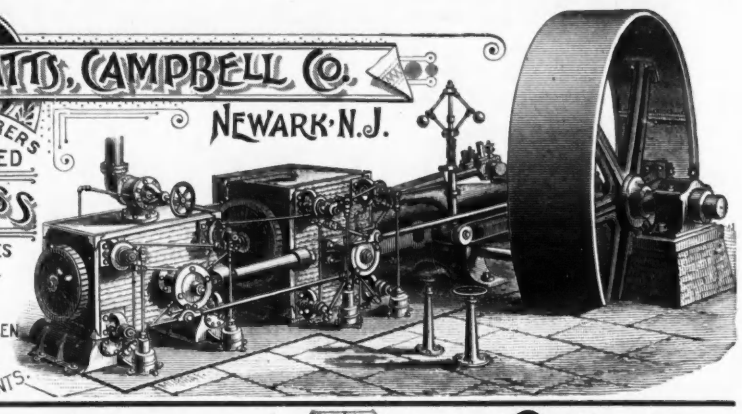

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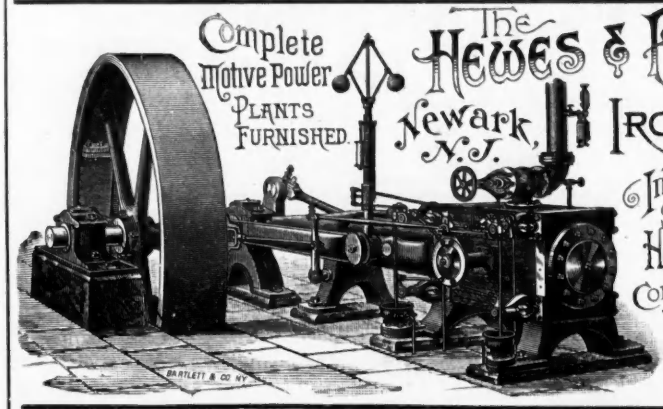

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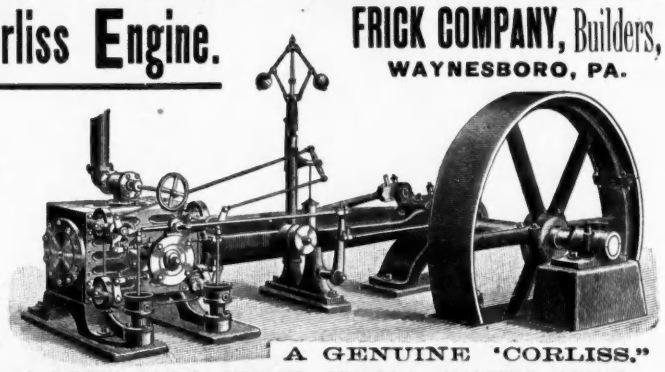

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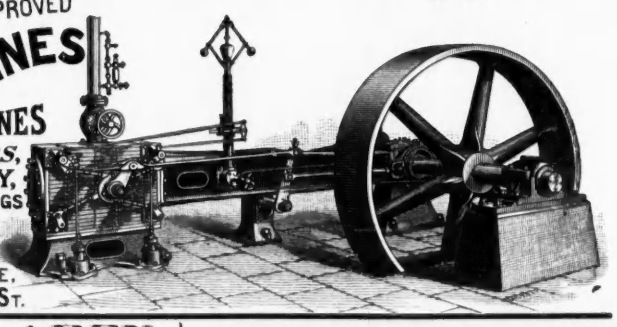

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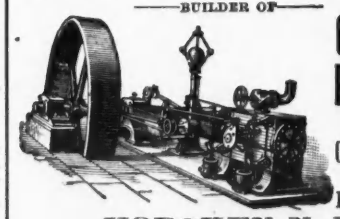

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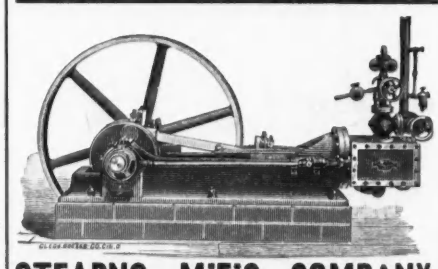

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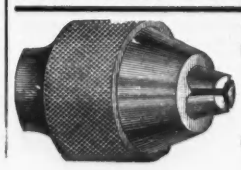

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Providence	"	"	24 "	"	5 " "
Hendey	"	"	26 "	"	6 " "
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Hendey Shaper. 24 in. stroke. Fine condition.
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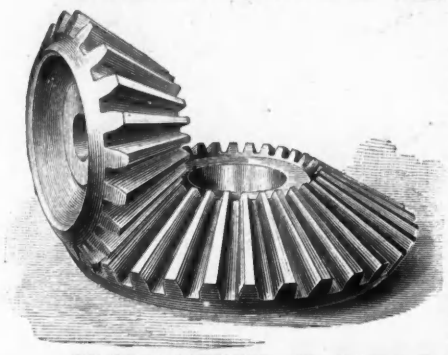

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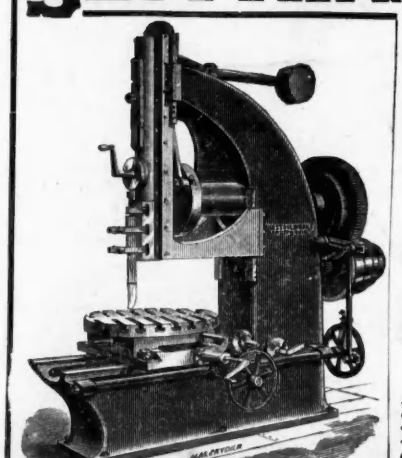

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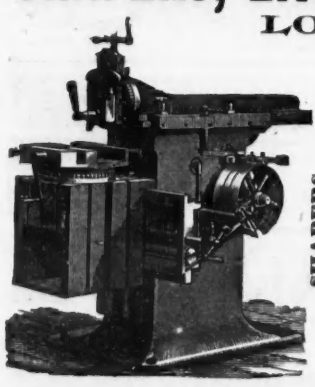

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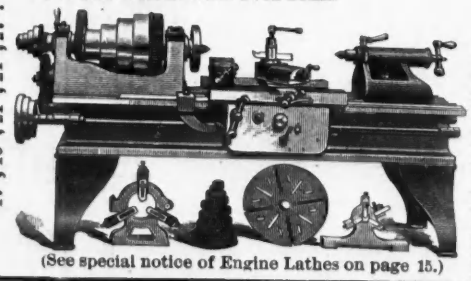

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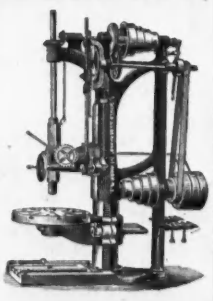

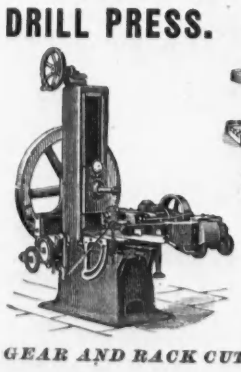

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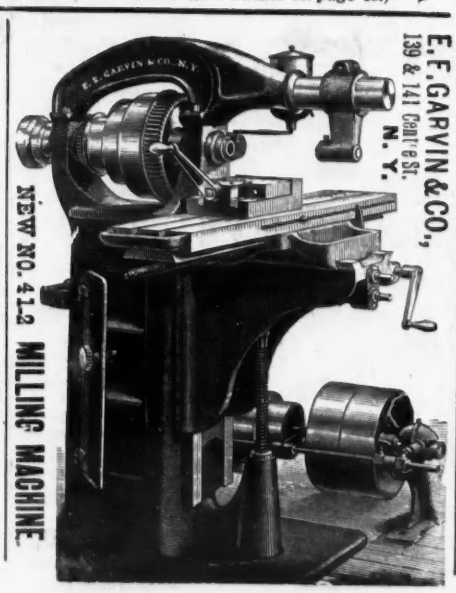

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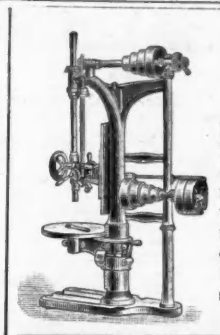

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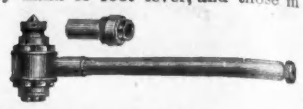

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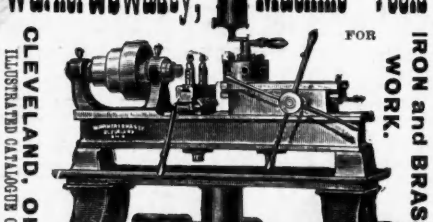

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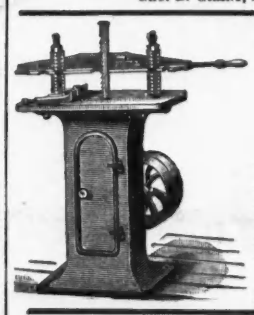

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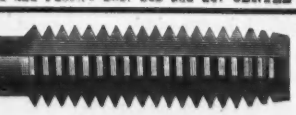

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